Heating Piping & Air Conditioning

DECEMBER 1957

Single copy price 75c

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INDUSTRIAL • COMMERCIAL • INSTITUTIONAL • PUBLIC BUILDINGS

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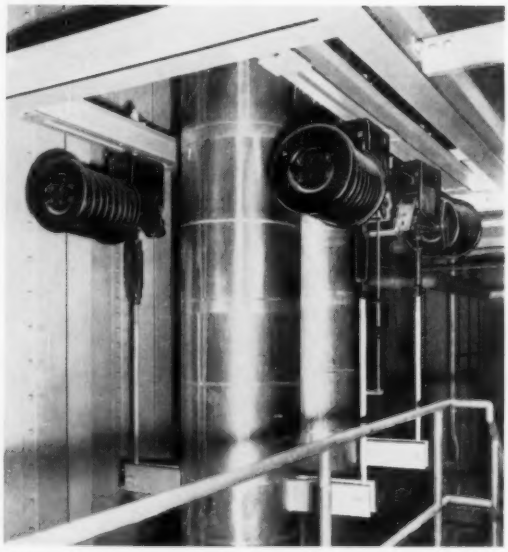
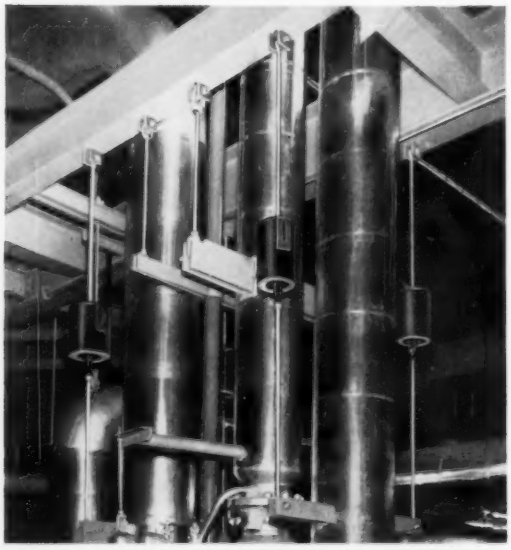
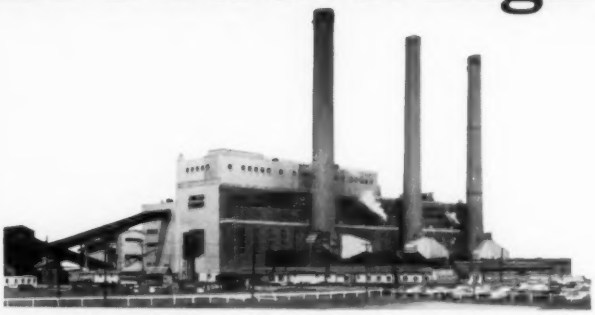
For Indianapolis Power & Light



Grinnell Model R Constant-Support Hangers on cold reheat riser piping. Constancy of support which hangers provide is mathematically perfect for all positions of travel. Note low headroom requirement. Hangers available in sizes for loads ranging from 30 lbs. to 32,260 lbs., with travels up to 12 inches.



Grinnell B-268 Pre-Engineered Spring Hangers on boiler feed piping. Patented precompression feature assures operation of spring within its proper working range. Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes. Available in 21 sizes for loads ranging from 50 lbs. to 28,200 lbs.



H. T. Pritchard Generating Station, Indianapolis Power & Light Company

Pipe Hangers by Grinnell

Six generator units have been built at H. T. Pritchard Station of Indianapolis Power and Light Company since 1947, adding up to a total station capacity of 376,000 kw. In each unit built at this station, just as in every new station constructed by this company, Grinnell Pipe Hangers and Supports have been used exclusively.*

There's good reason why major power companies like Indianapolis Power & Light look to "America's #1 Supplier of Pipe Hangers and Supports." A volume producer of pipe hangers, Grinnell backs up this advantage with an efficient coast-to-coast distribution system of warehouses and jobbers. You can depend on Grinnell for quick deliveries. In fact, even complex hanger requirements often can be met with hanger assemblies right off the shelf. This not only saves you time — but it can save you money, by cutting down on the number of special items which must be manufactured.

Benefit from expert knowledge gained during more than a century of piping experience. On your next piping job, specify Grinnell.

*Work done in collaboration with Gibbs & Hill, Inc., N.Y.C.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island — **Coast-to-Coast Network of Branch Warehouses and Distributors**

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

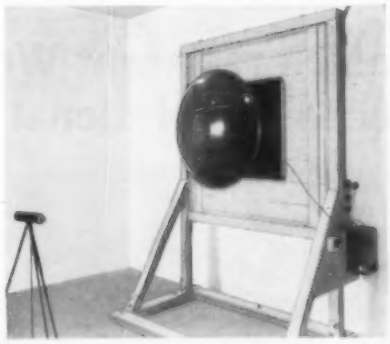
CALIBRATED REVERBERATION TEST ROOMS

Cutaway view of DeBothezat's noise evaluation reverberation test rooms, designed and calibrated by the acoustics staff of Armour Research Foundation.

Fan noise control begins Here

THESE REVERBERATION ROOMS are only a part of DeBothezat's continuing research program devoted to *predicting and reducing fan noise.* It's here that DeBothezat obtains the sound-output ratings (on both inlet and outlet sides) that are now available on all DeBothezat fan units, tested as a complete assembly.

Ratings are stated in both microwatts sound power and decibel sound pressure level in each of 8 octave bands of frequencies, measured separately. Next time you specify or install fans, ask your DeBothezat Sales Engineer for full information.



Interior view of the air outlet side of a DeBothezat noise evaluation reverberation test room, with a Power-Flow Roof Ventilator on test. Sound-level meter and microphone are in position — octave band analyzer not shown.

"Controlling Ventilation Noises"

$2 PREPAID

when requested on your business letterhead

De Bothezat FANS

A DIVISION OF

American Machine and Metals, Inc.

Dept. HP-1257, EAST MOLINE, ILLINOIS

IN CANADA: Represented by DOUGLAS ENGINEERING CO., Ltd., Toronto • Montreal

Workmen replace sand around wrought iron rink piping during the off season at the Montreal Forum, home ice of the Montreal Canadiens.

Corrosion resistant Wrought Iron pipes the brine to freeze this National Hockey League rink

Dependable wrought iron pipe assures a solid freeze for this hockey action between the Montreal Canadiens and the New York Rangers at the Forum.

Original wrought iron rink piping installed in 1924, still carries brine to freeze the ice at the Montreal Forum.

That's a lot of corrosive service for one piping material. Yet, every year, from September to May, owners report that wrought iron pipe performs this task with a minimum of maintenance.

Rink piping at the Forum is embedded in sand with no permanent floor above. For events requiring no ice, the ice surface is covered with large wooden panels. There is no ice removal at the Forum from September to early May.

Wrought iron pipe also provides a dependable playing surface in these other National Hockey League rinks: Madison Square Garden, home ice of the New York Rangers; Maple Leaf Gardens, home ice of the Toronto Maple Leafs; and, the Chicago Stadium, home ice of the Chicago Black Hawks.

With so many new rinks and arenas entering the planning stage, it will pay you to read our *Special Report—Ice Skating Rinks—Their Construction and Maintenance.* Write for a copy. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

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BYERS Wrought Iron Tubular and Hot Rolled Products

ALSO ELECTRIC FURNACE QUALITY STEEL PRODUCTS

Corrosion costs you more than Wrought Iron

Heating Piping & Air Conditioning

Vol. 29 No. 12

(With which is merged the Aerologist)

DESIGN, INSTALLATION, OPERATION AND MAINTENANCE IN INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND PUBLIC BUILDINGS

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One of a series.

Some Things to Think About Steam Traps

...in order to get high operating efficiency and a minimum of maintenance

The gentleman who invented the wheel had a basic idea and so far no one has come up with anything better for the purpose.

If you'll pardon us for a little overemphasis on the significance of steam traps, we'd like to liken one of them to the wheel.

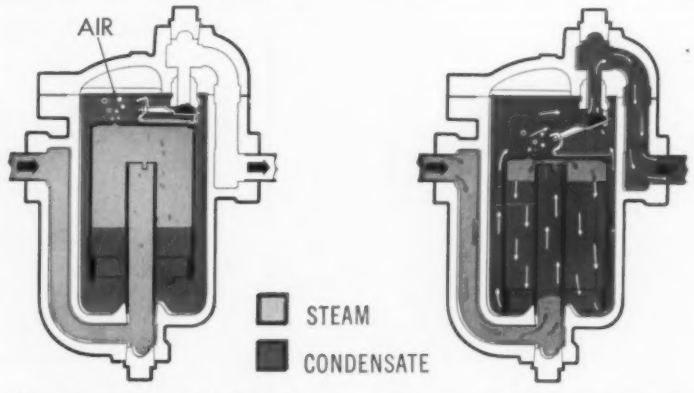
In 1911, when the first Armstrong inverted bucket steam trap model was announced to the world, or at least that part of the world that modest advertising and sales budgets would cover, it was not received with equal enthusiasm by all (especially old-style trap makers). But, like the wheel, it managed to find its way into general use. And, nothing better has ever turned up for the purpose of draining condensate. As a matter of fact, the Armstrong trap has been very widely copied. Today, there are more inverted bucket traps draining process equipment than any other kind. Of these, there are more Armstrongs.

If this sounds like the boasting of a proud parent, give consideration to some fundamental requirements not met by all traps:

1. ***A steam trap should not leak steam.*** Some traps do, you know, because of the nature of their operating principle. No steam ever gets to the Armstrong trap orifice. The valve is always water sealed.

2. ***A steam trap should vent "air" as fast as it accumulates***—otherwise temperatures are reduced and corrosion is a problem. The Armstrong trap handles air very nicely. The vent in the bucket permits air to accumulate in the top of the trap, from where it is discharged when the trap opens. For extreme conditions like draining paper machine dryers, some jacketed kettles and certain other units, the vent is sized larger for the job. And, for handling big volumes of air during warm-up, a bucket with an auxiliary thermic vent really speeds up heating.

3. ***A steam trap should discharge condensate at steam temperature*** if you want to get maximum efficiency from the unit drained. And most people certainly do. If you have to wait for the condensate to cool, it's almost impossible to maintain maximum temperatures and prevent air build-up. You guessed it—the Armstrong trap opens for water, without dependence on temperature.



Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

4. ***A steam trap should be suitable for any return system.*** The Armstrong trap works just the same whether discharging to atmosphere, back pressure or vacuum. It has been conclusively proved that flash steam resulting from use of a bucket trap does not cause a problem in vacuum return systems. The flash condenses rapidly. It's the leaky traps that cause the headaches.

5. ***A steam trap should not be a "prima donna".*** Some kinds of traps take an awful lot of care and coddling. The Armstrong trap is a rough and ready type with a hardened chrome steel constitution (valve and seat, to be exact). It cleans itself of ordinary dirt and scale without choking up. Its 18-8 stainless parts stave off rust and corrosion. It resists wire-drawing and wear remarkably well. In fact, it stays on the job longer with less attention than any trap ever produced. Unless you live in Siberia, you can probably find a user around the corner who will tell you so from experience.

6. ***A trap should not be an "orphan".*** With Armstrong traps you can *always* get prompt service and parts from nearby Factory Representatives and stocking distributors as well as from the factory.

7. ***A trap should have a guarantee.*** The Armstrong trap is unconditionally guaranteed to give you *complete satisfaction* (as to doing its job, that is). If it doesn't, you can get your money back.

If you'd like to buy some of these excellent steam traps, call your local Armstrong Representative or write **Armstrong Machine Works, 8743 Maple St., Three Rivers, Michigan.**

ASK FOR the 44-page Steam Trap Book, free on request without obligation.

ARMSTRONG STEAM TRAPS

AUTOMATICALLY BETTER AIR FILTRATION

The FAR-AIR Roll-Kleen is automatic air filtration at its best. This modern filter combines simplified design, automatic operation and high efficiency media to give once-a-year maintenance. Special high capacity media with leno weave backing to prevent entrainment, SIMPLIFIED DESIGN, time-tested gearmotors, and a sealing system that prevents air by-pass contribute to the high efficiency and virtually maintenance-free operation. The ROLL-KLEEN is available to meet any cfm requirement. Roll-Kleen is just one of a wide variety of FAR-AIR quality products designed to solve your air cleaning problems.

Write for Bulletin B-1400-2, Farr Company, P.O. Box 45187, Airport Station, Los Angeles 45, California.

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1", 2" & 4"
Panel filters.
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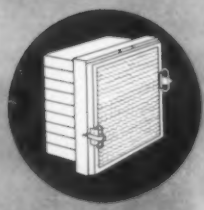

HP PAPER
AFTER-FILTER
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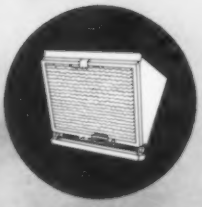
MICROLOC
Renewable media filter.
Bulletin B-1303-1



GREASE
ELIMINATOR
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F/S FILTER
Permanent, economical.
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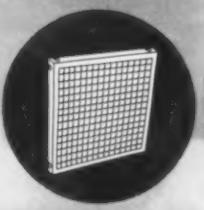

D/C FILTER
Disposable media filter.
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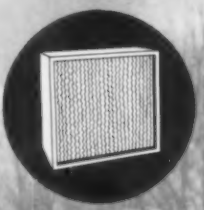

MAGNAMEDIA
Particulate filter.
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In 1907 ST. BONIFACE HOSPITAL Pioneered with

ST. BONIFACE HOSPITAL, located across the Red River from Winnipeg, Man., is one of the largest hospitals in Western Canada. It was built and is operated by the order of the Grey Nuns of Montreal.

Architects and Engineers:
GREEN BLANKSTEIN RUSSELL & ASSOCIATES, Winnipeg, Man.

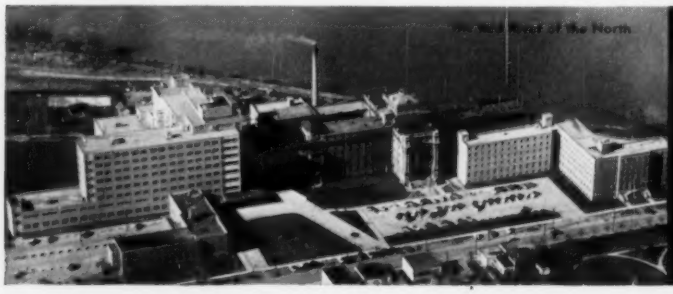
Air Conditioning Engineers:
CARRIER ENGINEERING LTD.

Plumbing & Heating Contractors:
New Wing, **BOWYER-BOAG LTD.**

Old Section and Nurses Residence,
MIKKELSEN-COWARD & CO. LTD.

Cobalt 60 Unit above is one of the many features in the completely equipped Radiology department. It is a high energy source, for treatment of cancer and other malignancies.

In the Board Room, left to right, Dr. Paul L'Heureux, Medical Director, Sister Superior G. Jarbeau, Administrator and her Assistant Sr. A. Trottier, Mr. G. L. Pickering, Comptroller. Below on opposite page is Chief Engineer Louis Verscheure at air conditioning control panel.



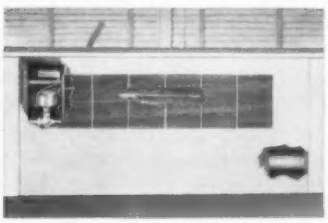
POWERS Pneumatic Temperature Control for Heating

NOW, it's Canada's First Completely Air Conditioned Hospital with

Powers Temperature and Humidity Control helps Nurses to work more effectively and care for more patients. Surgeons operate with less fatigue and strain. Patients recover sooner and require less service.

Powers Pneumatic Thermostats maintain set temperatures constantly. They need no daily checking or readjusting.

Over 619 Powers Heating-Cooling Thermostats and 708 PACKLESS Control Valves regulate the volume of chilled or heated water to unit air conditioners used in the perimeter areas of the buildings.



POWERS Quality System of Air Conditioning Control

St. Boniface Hospital with 670 beds, offers the most advanced facilities and equipment for diagnosis and treatment of disease, patient care and comfort.

Year 'round Air Conditioning regulated by Powers individual room control provides the right temperature required for every hospital activity. Powers pneumatic thermostats are used in:

13 OPERATING ROOMS, central sterilizing and supply area, recovery and delivery rooms, 9 nurseries, attractive rooms for patients, offices, public spaces, pharmacy, laboratories, radiology and therapy departments, kitchen, cafeteria and dining rooms, laundry, autopsy room, solariums for convalescent patients and a colorful playroom for children.

Central Supply Units furnish properly conditioned primary air and heated or chilled water to over 600 unit air conditioners in the perimeter areas of the buildings. Occupants in each space can dial the temperature they like best.

Interior Zones, operating rooms and other spaces receive conditioned air from central supply units. Here Powers control automatically adjusts temperature and humidity to the requirements of occupancy and outside weather.

Nurses Home and School of Nursing with over 200 students, have direct radiation throughout controlled by Powers.

Powers Thermostatic Shower Controls insure comfort and safety of patients and nurses.

Are You Planning a New Hospital or any other type of building? Ask your architect or engineer to include a Powers Quality System of Temperature Control. You will help insure utmost comfort and lowest cost for upkeep.

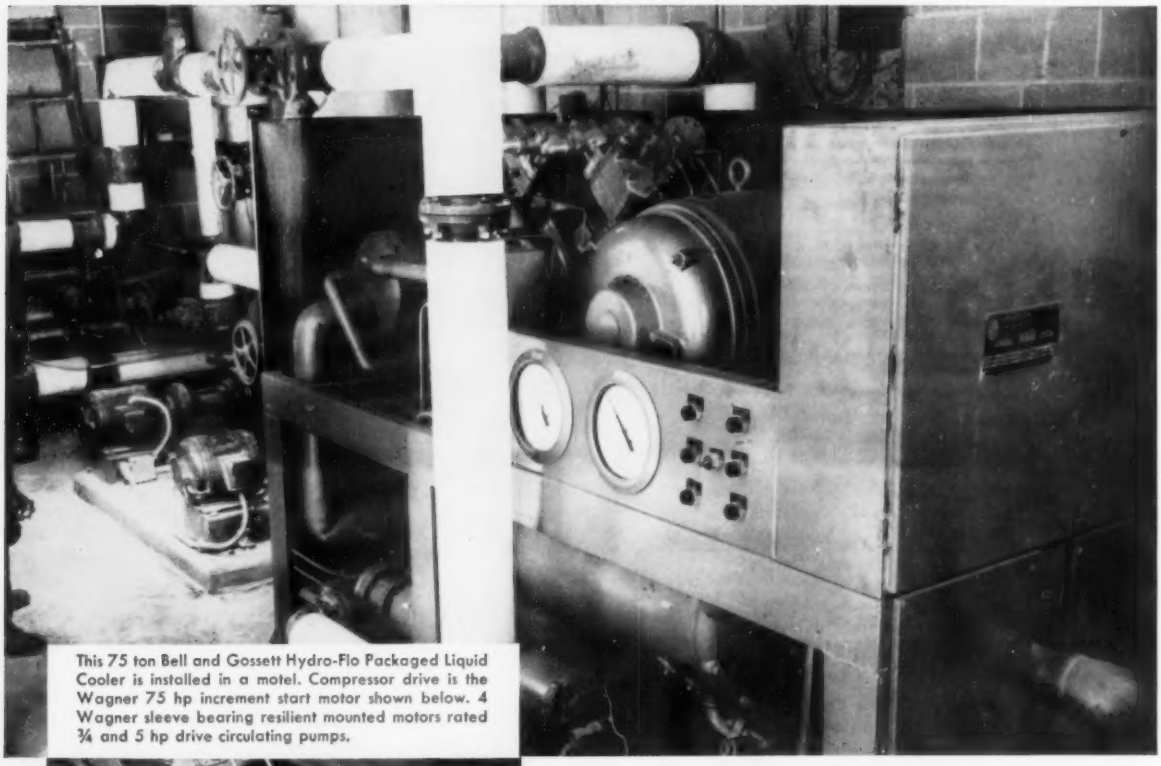
THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in Chief Cities in U.S.A., Canada and Mexico*

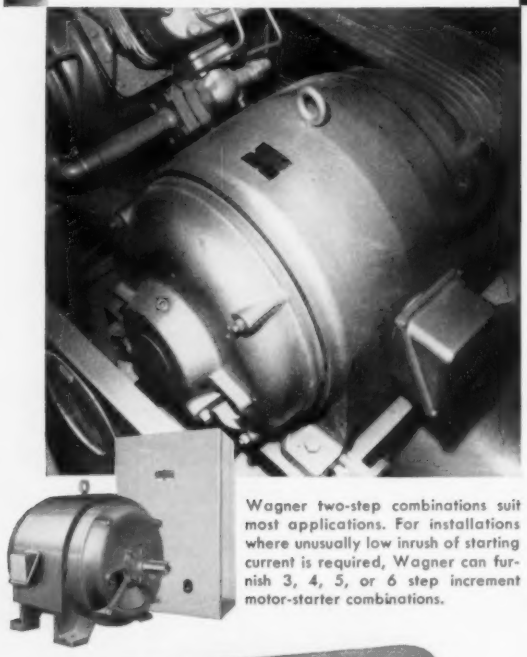
65 Years of Automatic Temperature and Humidity Control

(C49)

WAGNER ELECTRIC MOTORS . . . THE CHOICE OF LEADERS IN INDUSTRY



This 75 ton Bell and Gossett Hydro-Flo Packaged Liquid Cooler is installed in a motel. Compressor drive is the Wagner 75 hp increment start motor shown below. 4 Wagner sleeve bearing resilient mounted motors rated ¾ and 5 hp drive circulating pumps.



Wagner two-step combinations suit most applications. For installations where unusually low inrush of starting current is required, Wagner can furnish 3, 4, 5, or 6 step increment motor-starter combinations.

WAGNER

Increment Motor-Starter Combinations limit inrush of current when starting big motors

Part-winding starting is a good low-cost way to limit inrush of starting current on large squirrel-cage motor installations. Wagner Increment Motor-Starter Combinations permit such starting—meet all polyphase motor starting recommendations of AEIC—EEI—NEMA—and provide many years of troublefree operation.

These Wagner motor-starter combinations are not bulky, are easy to install, and are *proven* efficient and dependable in operation—Wagner has been supplying these combinations for over 17 years.

Why don't you investigate Wagner Increment Motor operation? Ask your nearby Wagner engineer to take you to an installation in your area. See how it works—judge for yourself, and then let him help you select the combination that meets your requirements. Call the nearest of our 32 branch offices, or write for Bulletins MU-128 and MU-195.

Wagner Electric Corporation
SERVING INDUSTRY SINCE 1891

H57-14

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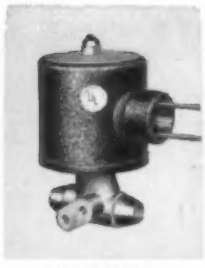

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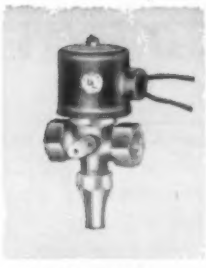

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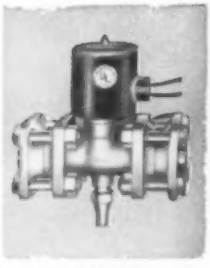

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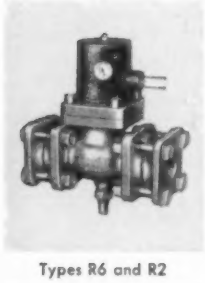

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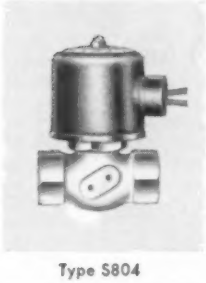

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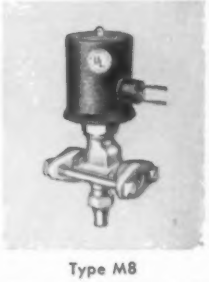
Type M9115



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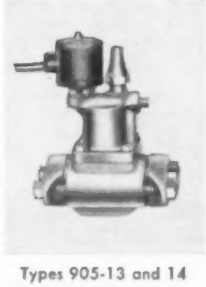
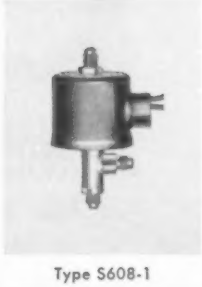
Type DS2228



Types 905-13 and 14



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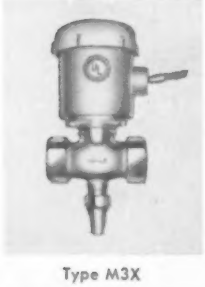

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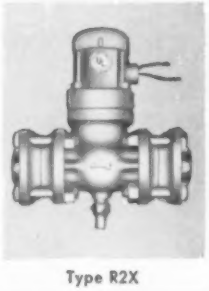
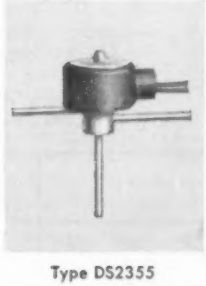


Type R2X

Type SIM55



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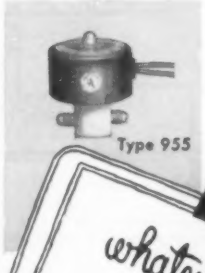

Type 955

Type D953

Type DS1770

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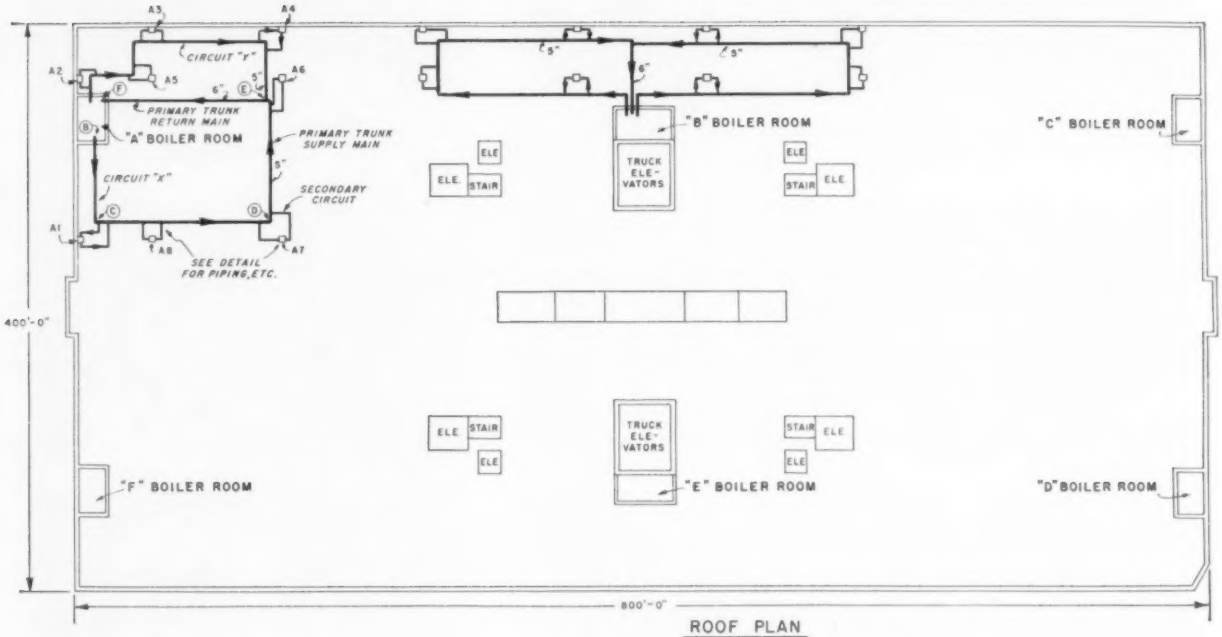
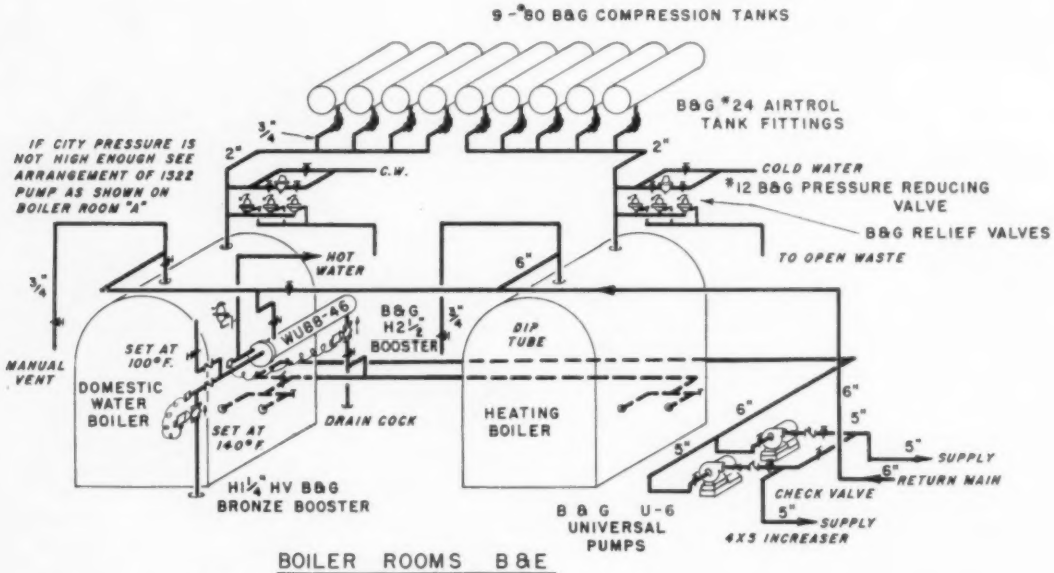
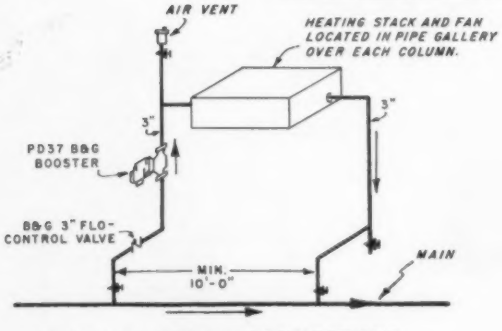


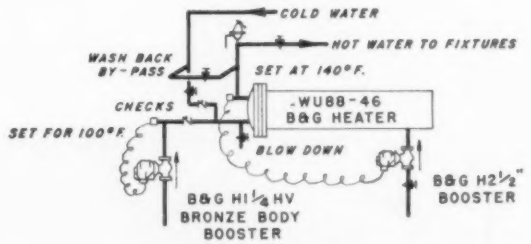
ROOF PLAN



BOILER ROOMS B&E



HEATING STACK CONNECTIONS



DOMESTIC WATER DETAIL

HEATING SYSTEM DESIGN

A unique one-pipe forced hot water heating system for a cold storage warehouse. The system provides heated air for ventilation and for heating the work area.

In this six story building, the center portion is cold storage area with space left along the outer walls for truck travel. The basic problem was to replace exhaust fumes from the trucks with fresh air and to maintain temperatures which would provide satisfactory working conditions. Design temperature was 40°F to 55°F.

The plan finally selected called for division of the building into six symmetrical areas, with a boiler plant for each located on the roof. The system provides hollow columns, through which tempered air is forced, discharging through damper-controlled nozzles at each floor. The piping, heating stacks, coils and secondary pumps are located in a roof space.

B&G UNIVERSAL PUMP

LOCAL CONTROL PROVIDED BY B&G SECONDARY PUMPING CIRCUITS

The distribution system calls for primary and secondary pumping. Primary pumps continuously circulate the main circuits and secondary pumps, under local control, circulate the individual heating stack coils at the top of each heating column.

Complete details of this installation are given in the B&G Engineering Manual. Ask your local B&G Representative for a copy.

B&G "PD" BOOSTER

B&G CIRCULATORS...FOR QUIET, DEPENDABLE, LEAK-PROOF OPERATION

In circulated water heating and cooling systems, *quiet* pump operation is all-important. Transmission of pump noise through the piping system can penalize careful designing and installation.

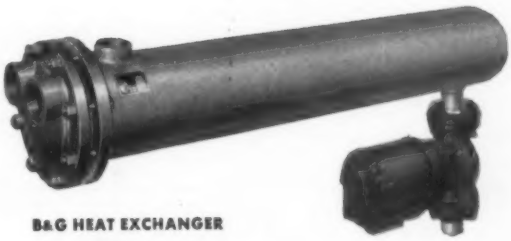
B&G Universal and Booster Pumps are engineered and built to meet the exacting demands of circulated water systems. They are distinguished by numerous features which assure *silent, vibrationless* operation. Among them are specially built motors, selected and tested for quietness... oversize shafts of hardened alloy steel... long sleeve bearings...noise dampening, spring-type couplers...oil lubrication...and leak-proof, diamond-hard "Remite" mechanical seals.

These pumps are of vertical, split case design and can be easily serviced without breaking pipe connections or motor leads.

B&G "WU" HEAT EXCHANGER...FOR LARGE CAPACITY IN A SMALL UNIT

This instantaneous water heater is equipped with a B&G Booster which pumps boiler water through the baffled shell, thereby greatly increasing the capacity of the heater. Thermostatic control of the Booster assures positive control of service water temperature.

"WU" Heat Exchangers can be installed on hot water boilers or below the water line of steam boilers.



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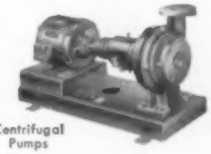
Water Heaters

Flo-Control Valves

Compression Tanks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Package Liquid Coolers

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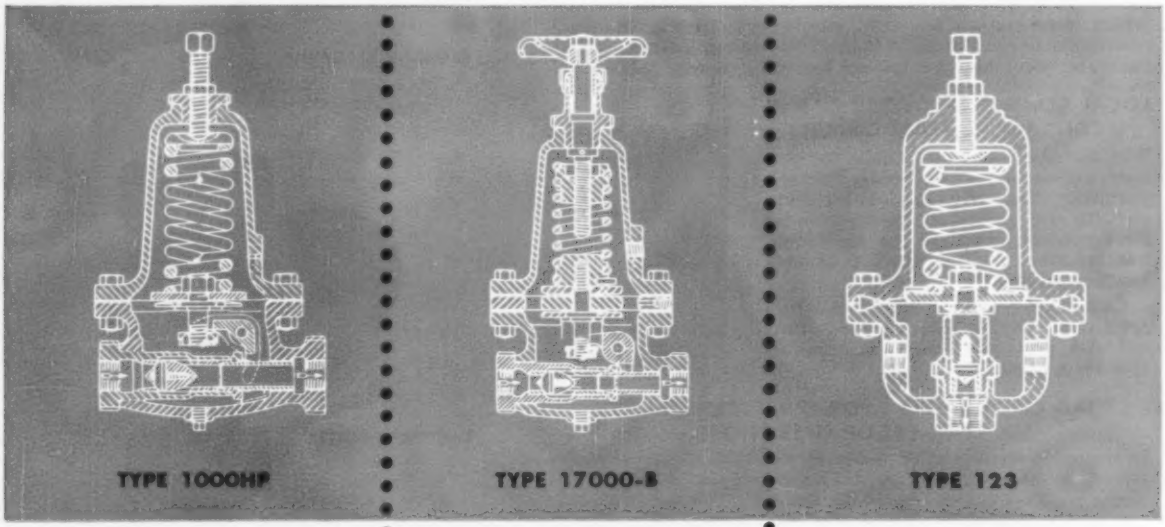


TYPE 1000HP | TYPE 17000-B | TYPE 123

PRESSURE REDUCING VALVE

A streamlined high capacity valve for close pressure regulation—accurate even under toughest working conditions. Closes against the flow, eliminating conditions that cause chatter. Two types available: for high pressures and for low pressures. Recommended for steam, water, air, oil and most gases and chemicals. Screwed ends, sizes: ¼" to 2".

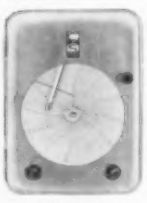
DIFFERENTIAL CONTROL VALVE

Maintains constant differential pressure between atomizing steam and fuel oil. Non-rising type adjusting screw adjusts spring either under tension or compression for maintaining steam above or below fuel oil pressure, depending on type of burner employed. Iron, bronze or steel body; bronze or stainless steel trim. Screwed ends, sizes ¼" to 2" with expanded outlets when desired.

RELIEF VALVE

Maintains a desired inlet pressure by relieving into relief line provided or protects equipment against high pressure line surges. For water, oils, air, gases, slurries and many other fluids. Bottom connection is outlet or discharge connection. Two side inlet connections permit installation in the line or as an angle valve with one side inlet plugged. For relief pressures to 325 lbs. and temperatures to 500° F. Screwed ends, sizes: ¼" to 2"; flanged ends, size ½".

Cash Standard
Stacon Series V Self Operating Temperature Regulators



Type 57
Recording Controllers

Type 30
Diaphragm Control Valve
With Type 51 Indicating
Controller Mounted

Type 44
Pilot Operated Pressure
Regulator

Type 100
Positioning Controller

Contact the Cash Standard control specialist in your area or write Dept. B

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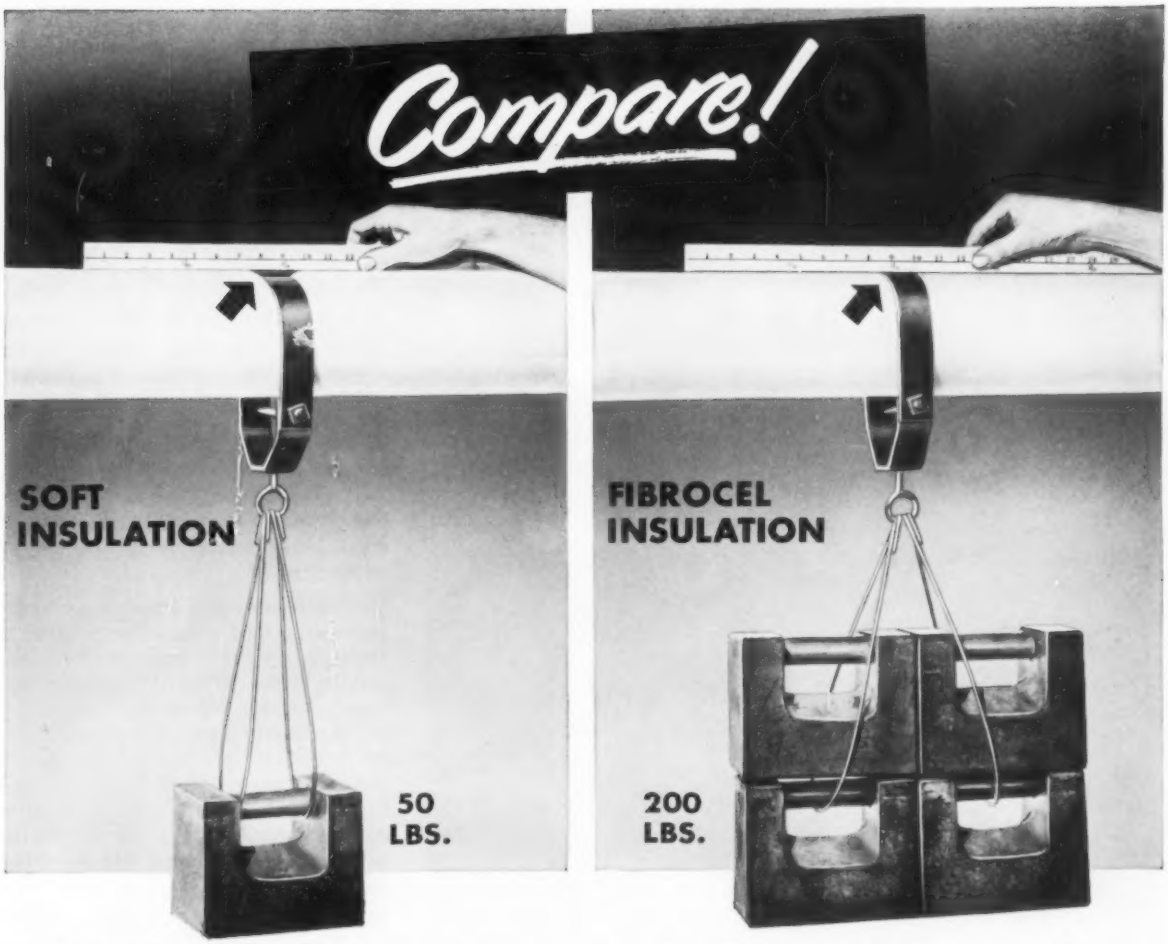
PRESSURE, HYDRAULIC, TEMPERATURE, PROCESS AND COMBUSTION CONTROLS



Compression test proves J-M Fibrocel® Insulation retains *FULL-WALL* thickness!

ONLY FIBROCEL OFFERS ALL THESE ADVANTAGES

No shrinkage—eliminates gaping joints. **Resists compression**—retains full-wall thickness. **Uniform dimensions**—precision formed for exact fit. **Economical application**—lightweight, easy to cut with a knife. **Thermally effective. Long lasting**—flame, rot, odor and vermin proof.

the new molded silica insulation developed for plumbing, heating, chilled water and dual service applications in the 35F to 300F temperature range

The illustrations tell you why Fibrocel maintains its insulating effectiveness . . . why it stands up under operating abuse which often impairs the performance of softer insulations.

At top left, a *single* 50-lb. weight noticeably crushes the soft ordinary insulation. But note that *four* of these same weights cause no deformation or compression in Fibrocel. *This means full insulating effectiveness!*

Fibrocel's added firmness and strength take on even more importance when a vapor seal jacket is involved. For Fibrocel offers substantially greater back-up protection against jacket punctures.

Fibrocel speeds installation, too! It is light in weight and a pleasure to apply. It cuts cleanly, easily with a knife. And its firmness and remarkable dimensional uniformity assure long-lasting, tight, smooth joints!

For further information on Fibrocel, write Johns-Manville, Box 14, New York 16, N. Y. (In Canada, Port Credit, Ontario.) Ask for brochure IN-155A.

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Johns-Manville *first-in* INSULATION

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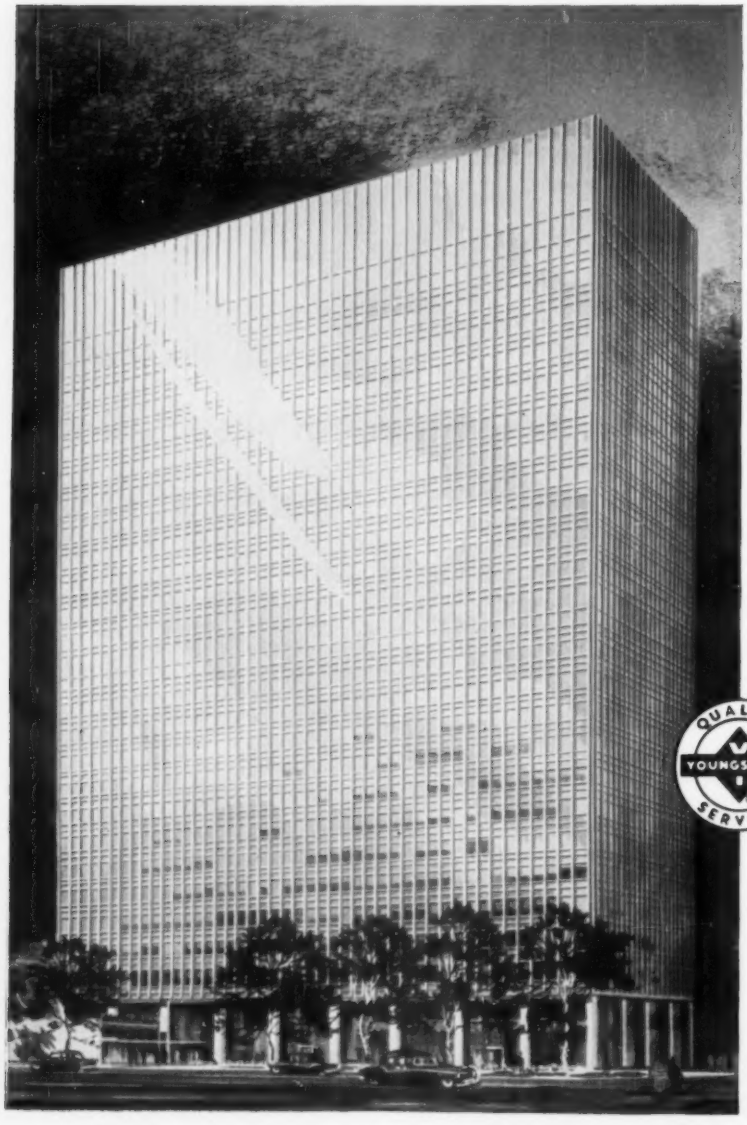
General Contractor: George A Fuller Company, New York, N. Y.
Structural & Mechanical Engineers: McGeorge Hargett & Associates
Consulting Mechanical Engineers: Jaros, Baum & Bolles
Heating & Air Conditioning Contractor: The Feldman Bros. Company, Cleveland, Ohio
Distributor: Grinnell Company, Cleveland



Cleveland's newest architectural beauty — this modernistic 22-story Illuminating Building — will provide much-needed air-conditioned office space for the "Best Location in the Nation". Owner of the new structure, 55 Public Square, Inc., and the architects, wisely chose Youngstown Steel Pipe to provide for a long-lived, dependable water supply system.

Youngstown Steel Pipe is the best pipe obtainable—anywhere. That's because it's made from our highest quality steel by men who have devoted their lives to the pipemaking business. Each and every step in Youngstown's completely integrated operations is closely quality-controlled by expert metallurgists to guarantee pipe that will meet your most exacting specifications.

Your nearby Youngstown Pipe Distributor has complete and ample stocks in all sizes. Why not call him today and discuss your requirements?

Specify Youngstown and secure these 7 Points of uniform goodness

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- uniform threading
- uniform weldability
- uniform wall thickness and size
- uniform strength and toughness
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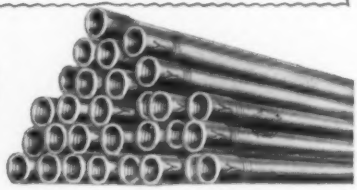
QUALITY YOUNGSTOWN SERVICE



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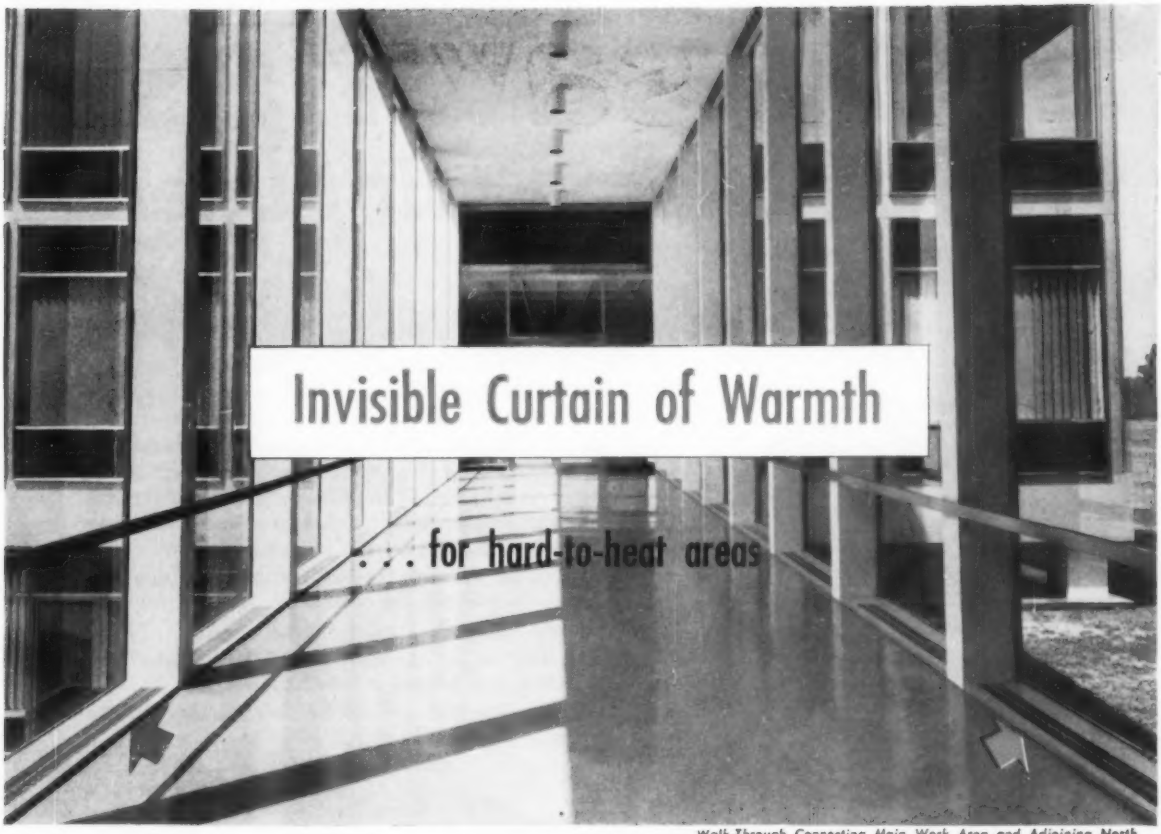

Walk-Through Connecting Main Work Area and Adjoining North Wing, Connecticut General Life Insurance Co., Bloomfield, Conn.

With *Vulcan* Fin-Tube Radiation

Set in the green, rolling hills of suburban Hartford, the new Connecticut General Life Insurance Company building is truly a modern classic — a marvel of planned efficiency dedicated to the working comfort of its employees.

Continuous glass areas, such as the walk-through shown above, called for positive, invisible warmth. Vulcan Fin-tube Radiation (installed between floor levels) was selected.

Standard of the industry, Vulcan continues to provide quality heating at lowest cost for commercial and industrial structures throughout America.

Connecticut General Life Insurance Company, Bloomfield. Skidmore, Owings & Merrill, architects, New York; Turner Construction Company, contractors, New York; Syska & Hennessy, mechanical engineers, New York.

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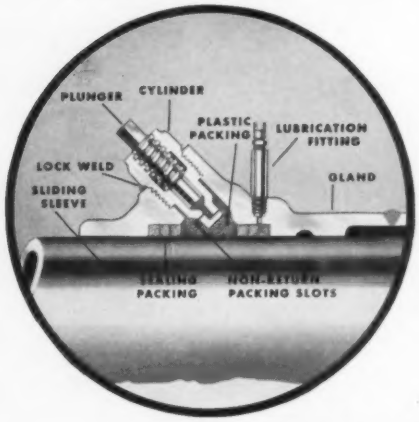
Hartford 6, Conn.

new savings
for expansion joint users

Cross-section of Gun-Pakt feature. To add packing, just add a plug and turn the plunger. Note non-return packing slots at bottom of cylinder.



The Yarway Type W Gun-Pakt Expansion Joint has an improved one-piece design of body and gland and improved method of packing that provide new maintenance economies and greater operating efficiency.

Bolted joint between body and gland is eliminated; the steel body includes gland and guide. Shorter face-to-face dimensions are possible. Improved angle of packing guns makes them more accessible and *permits injection of the special plastic packing directly into packing space.*

The famous Yarway *Gun-Pakt* feature permits *addition of packing under full steam pressure. No need for costly shutdowns to repack.*

Sizes 1½" to 30", pressures 150, 300, 400 psi. Single or double types, flanged or welding ends.

For full description, write for new Yarway Bulletin EJ-1916.

20" Yarway Type W Gun-Pakt Joint with base, single type, welding ends, 8 guns.

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YARWAY GUN-PAKT

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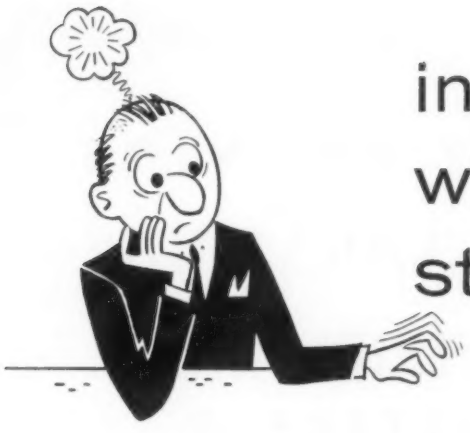

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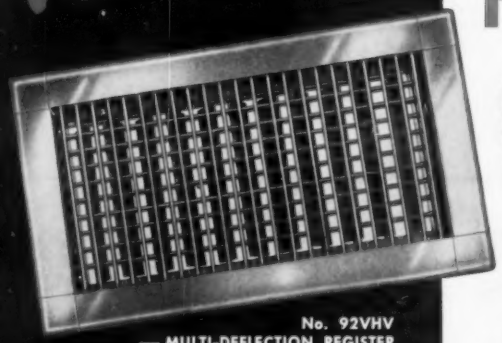

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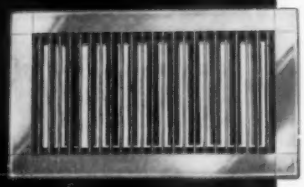
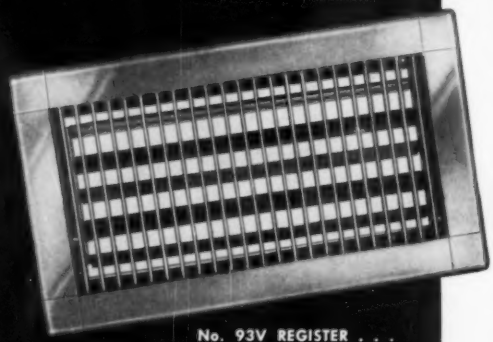
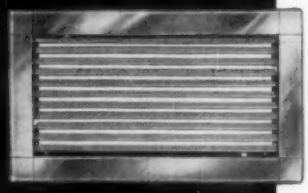




No. 93V REGISTER . . . vertical front bars set straight, horizontal louvers.

No. 94A GRILLE . . . horizontal face bars set at 22° angle for up or down deflection.



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REGISTERS & GRILLES for COMMERCIAL INSTALLATIONS

. . . are already downright favorites with a large and rapidly growing number of architects, air conditioning engineers and installers. For with this line it's never necessary to compromise. It permits you to readily achieve the exact air distribution, direction and volume best suited to each and every situation. There are 26 standard sizes, up to 36" x 12", offering 260 possible horizontal and vertical deflection combinations. Intermediate sizes up to 36" x 36" may be had on order. Front adjustments control face bars and louvers, and opposed louvers permit absolute volume control with equal distribution over entire face. Top quality "Decorator Gray" enamel finish. Your nearby H&C Jobber has complete details. We will be glad to furnish his name and location on request.

H&C FIXT-AIRE . . .

. . . return air registers and grilles designed to complement and harmonize with the TRIPL-AIRE line. Registers have a single bank of face bars in fixed vertical or horizontal position, and feature the same opposed louver construction for positive volume control found in TRIPL-AIRE units. Grilles are available with horizontal face bars set at 22° angle for up or down deflection where desired. One-piece sizes up to 36" x 30".

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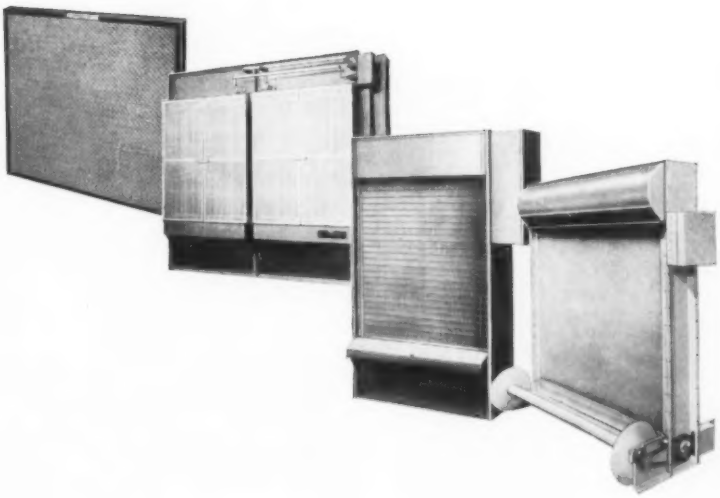
Dept. 2-AC HOLLAND, MICHIGAN

How efficient should air filters be?



. . . efficient enough to get the job done!

Obviously, you don't want an air filter that isn't efficient enough to remove the dust that's causing you trouble. On the other hand, AAF believes you shouldn't pay for *more* efficiency than you need . . . you shouldn't pay for a filter that removes fractional-micron dust particles *unless those particles are harming your operation.*

Different conditions require different degrees of air cleanliness. No one type of air filter can possibly be "right" for all. That's why it's important for you to discuss your air filtration problems with a company that makes *all kinds* of filters.

AAF manufactures more than a dozen different types. Don't buy any filter until you've been shown which one fits your needs, *and why!* Talk with your local AAF representative.

AAF American Air Filter
COMPANY, INC.
373 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal 9, P. Q.

Crane helps another valve user stop high replacement costs

How they solved valve failure on air service

This case history from Willamette Iron & Steel Co., Portland, Ore., shows how you can cut compressed air handling costs in your own plant.

These Crane packless diaphragm valves are handling 100 psi. air on manifolds to distribution lines used aboard ship during construction. Before installing the Crane ¾-inch No. 1610 valves, the yard was troubled by constantly rising maintenance costs. With the other make valves, diaphragms were rupturing after a short time, requiring continual replacement. Loss of air and air power for equipment was costly.

Crane packless diaphragm valves were installed because their neoprene diaphragm functions only as a bonnet seal, and is not subjected to crushing and wear when used as a seating member. The maintenance problem was effectively solved, as it is for so many users throughout industry, by installing the right Crane valve. Contact your Crane Representative today—ask him for complete information on any application.

ASK FOR Crane Folder AD-1942 on packless diaphragm valves. Contact your Crane Representative for a copy, or write to Crane Co., at address below.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

"Not only is this sheet easier to work...

but it takes every bend and fold...

without chipping or flaking, because...

Wheeling SOFTITE® has the tightest zinc coating yet produced"

What makes Wheeling SOFTITE different from other galvanized sheets? Just ask any sheet metal man or air conditioning contractor who has tried them.

They'll tell you that Wheeling SOFTITE takes every bend, every crimp, every tortuous fold without ever cracking or peeling. That's because SOFTITE is ductile, so it's easy to work. At the same time it has the tightest zinc coating yet produced. That's why SOFTITE ducts look so good, last so long, and give service above the call of duty.

If you would like to enjoy all these advantages, make a note right now to try Wheeling SOFTITE.

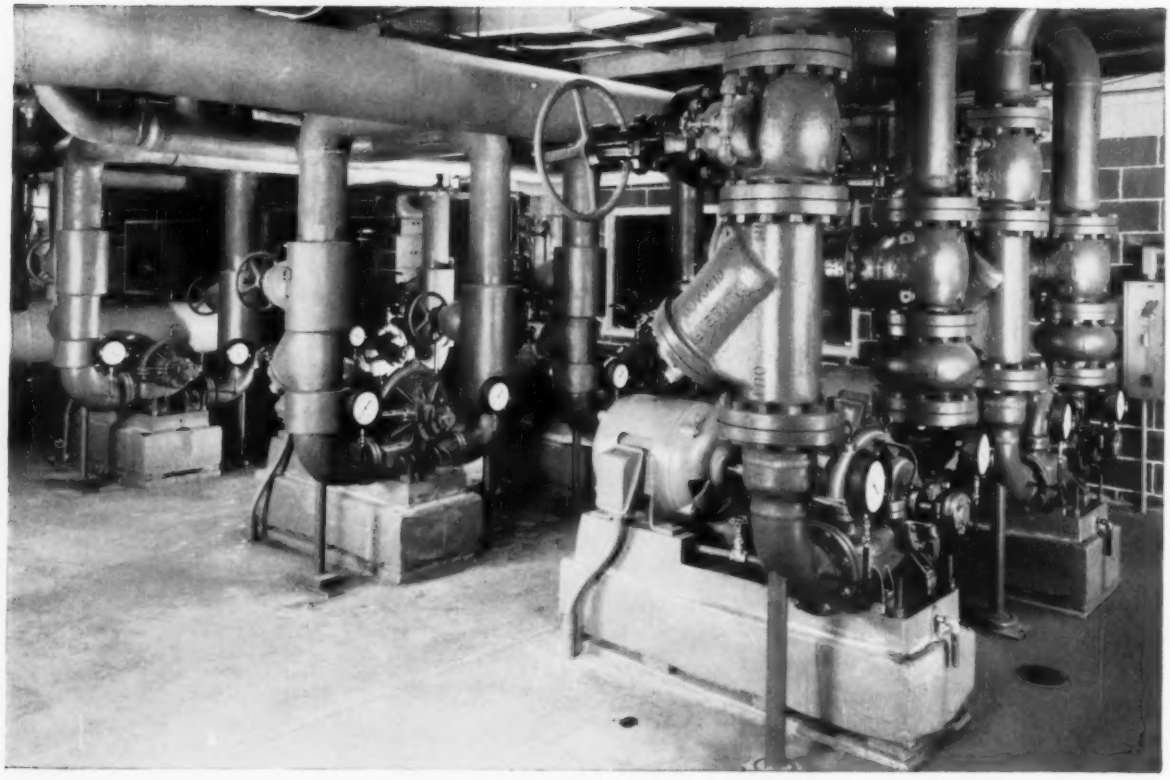
Call your Wheeling industrial supply distributor, the Wheeling sales office nearest you, or write Wheeling Steel Corporation, Wheeling, West Virginia.

IT'S WHEELING STEEL

WHEELING STEEL

District Sales Offices—Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Houston, New York, Philadelphia, St. Louis, San Francisco, Wheeling

OUR CHALLENGE STANDS: ANYTHING THAT CAN BE MADE OF STEEL SHEETS CAN BE MADE OF WHEELING SOFTITE GALVANIZED SHEETS



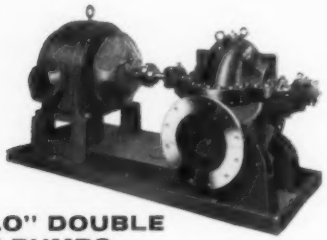
How do you guarantee successful pump installations?

Many rely on these "Buffalo" Pumps

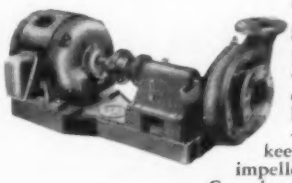
There's a "Buffalo" Pump that's sure to fit your installation needs perfectly . . . sure to deliver the utmost in economy, reliability and long-lasting performance on the job. For *two* reasons: *First* . . . "Buffalo" builds a line of pumps covering almost every type of liquid-moving requirement. All you do is select the *one* "Buffalo" Pump that exactly matches your installation needs. *Second* . . . When you choose your "Buffalo" Pump, you can be sure you're installing the very finest. For more than 80 years, engineers and contractors have relied on the rugged, dependable quality built into every "Buffalo" Pump. You can *depend* on "Buffalo" Pumps.

Whatever your pump problem, write us for engineering data. We'll gladly submit recommendations that will help you with your liquid-moving requirements.

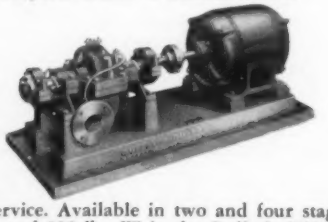
BUFFALO PUMPS
Division of Buffalo Forge Co.
171 Mortimer St. Buffalo, N.Y.
Canada Pumps, Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



"BUFFALO" DOUBLE SUCTION PUMPS
These pumps are designed for the finest performance possible in clear water service in 10 to 14,000 gpm capacities. Widely used for air conditioning service, because of their peak efficiency. Write for Bulletin 955-Q.



"BUFFALO" SINGLE SUCTION PUMPS
Husky pumps for husky jobs, with these outstanding features: oversize bearings capable of handling speeds up to 5000 rpm — sealed-in bearing housing to keep out foreign matter—enclosed impellers, to retain initial efficiency. Complete details in Bulletin 976-E.



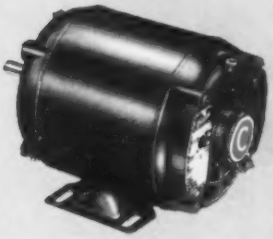
"BUFFALO" MULTISTAGE PUMPS
"Buffalo" Type "RR" Multistage Pumps are highly efficient for high pressure applications with clear water. Ideal for boiler feed service. Available in two and four stage designs, up to 900 gpm and 500 lbs. Write for Bulletin 980-D.

CENTURY HAS THE COMPLETE LINE . . .

Big as 400 H.P.

125 H.P. Type SC

small as 1/20 H.P.



WHATEVER YOUR APPLICATION THERE'S A Century MOTOR

Performance-Rated© to do the job

You'll get the top performance your equipment's designed for . . . because there's a motor *designed for it* in the Performance-Rated Century line.

Century's technique of Performance-Rating enables you to choose motors with the right size, speed, frame, and torque characteristics to fit—*exactly*—your application requirements.

You can select from a range of 400 to 1/20 h.p.; AC single or polyphase, or DC; drip proof, dust proof, or explosion proof frames. There are optional corrosion-resistant features; constant speed, multi-speed, varying or geared speeds.

Let us prove the value of Performance-Rating for you . . . without obligation. Call or write your nearby Century District Sales Office or Authorized Distributor.

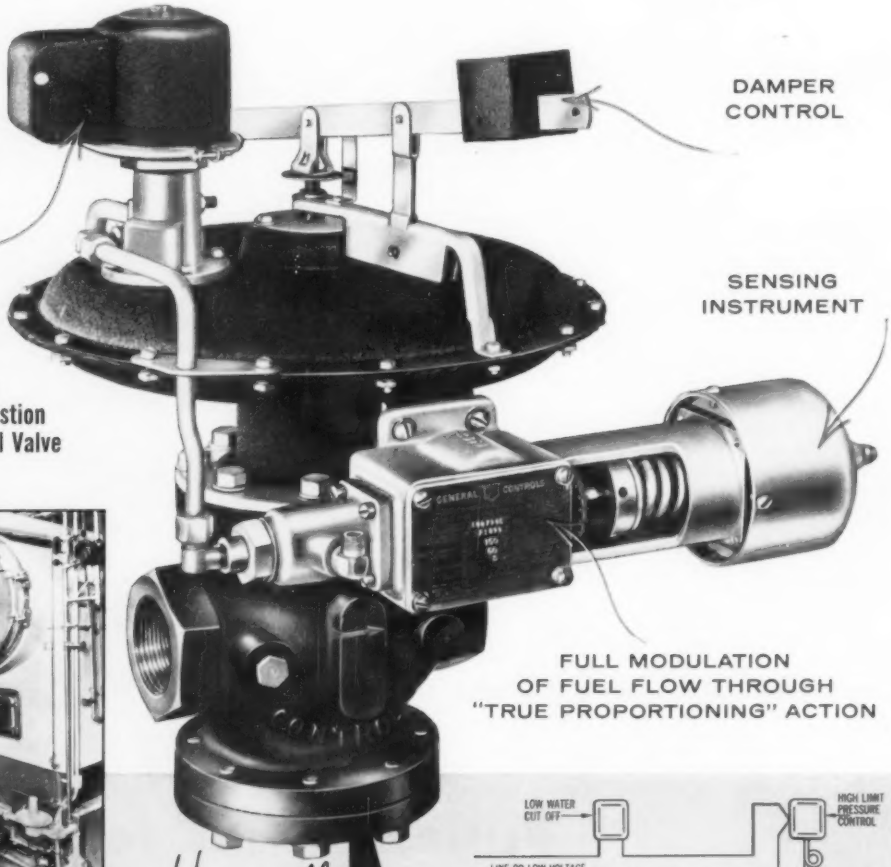
Performance-Rated©
MOTORS
1/20 to 400 H.P.

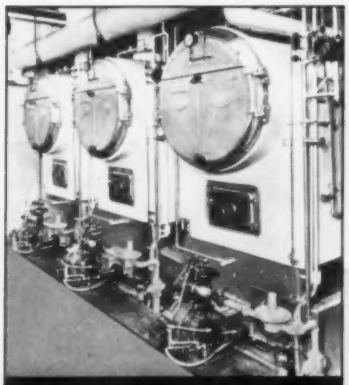
C CENTURY ELECTRIC COMPANY

1806 Pine Street • St. Louis 3, Missouri • Offices and Stock Points in Principal Cities

For Gas-Fired Boilers and Furnaces...

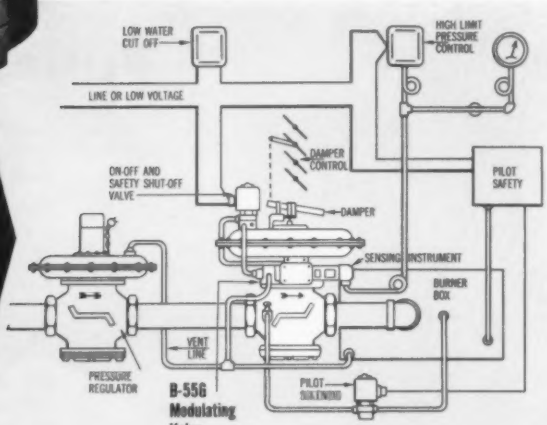
A Combustion Control System...


DAMPER CONTROL
ON-OFF SAFETY SHUT-OFF VALVE
SENSING INSTRUMENT
B-55G Combustion Control Valve
FULL MODULATION OF FUEL FLOW THROUGH "TRUE PROPORTIONING" ACTION



Note the clean, simplified arrangement of this B-55G installation—**one** valve doing the work of **four!**

Here's all you need for a complete Control System



GENERAL CONTROLS

America's Finest Automatic Controls for Home, Industry, and the Military

Glendale, California • Skokie, Illinois • Guelph, Ontario, Canada

Five Plants—42 factory branch offices serving the United States and Canada

... all in ONE VALVE!

for controlling:

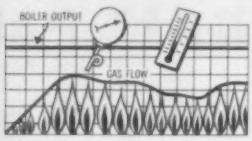
STEAM...HOT WATER...WARM AIR

ONE VALVE:

1 Safety Shut-Off
2 Proportioning
3 Damper Control
4 Temperature or Pressure Sensing

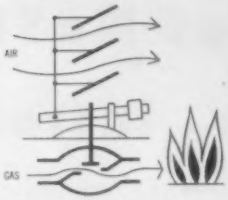
For steam...hot water...warm air... *ANY* commercial and industrial gas-fired equipment, *THIS single* valve can mean a world of difference in efficiency, safety and PROFITS. The B-55G is the only valve of its kind in existence and if you haven't had the opportunity to check out all its money-saving superiority, you've been missing a great advance in control systems! B-55G is available in sizes 1" ips to 6" flange, fully approved by AGA, FM and UL. Pressure and temperature ranges to 600 psi and 700°F. Send today for full information.

CONTROL



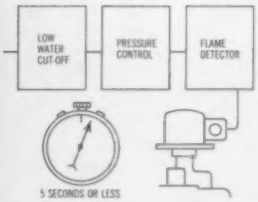
Full modulation provides steady boiler pressure (or furnace temperature) in response to changes in load. Variable speed of response eliminates "hunting" action. Valve moves slowly for slight changes, more rapidly for greater changes.

EFFICIENCY



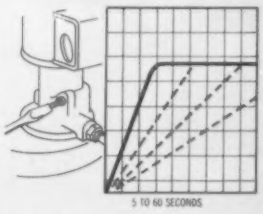
Proper fuel/air mixture is maintained throughout full throttling range of the valve. This means efficient, fuel-saving combustion for ALL firing conditions.

SAFETY



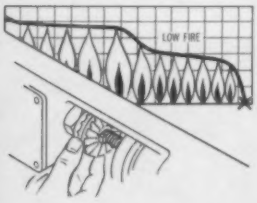
Quick-closing safety shut-off responds readily to high limit controls. Magnetic pilot valve overrides proportioning action—provides fast, positive shut-down.

DEPENDABLE STARTS



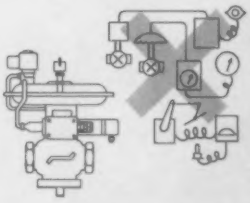
Opening speed is adjustable for best possible ignition and pick-up. You get safe, sure starts without roll-out explosions!

NO PUFF-BACK



Low-Fire position is adjustable for boiler "idling" at safe minimum flame. Quick closing action prevents flame flutter and dangerous puff-backs.

LOW COST



B-55G is ONE valve—replacing FOUR! It's easier to install, reduces maintenance time and costs, simple to operate and costs FAR LESS as original equipment!

Send today for complete information

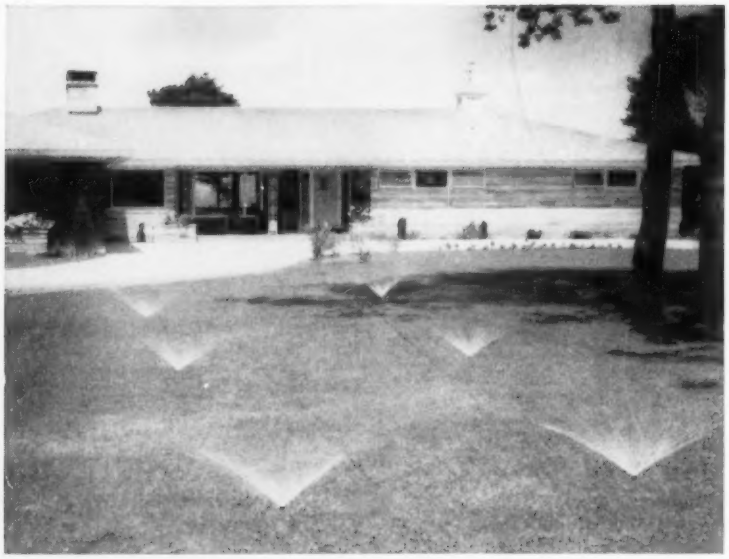
GENERAL CONTROLS • Dept. 1200-N
801 Allen Ave., Glendale 1, Calif.
OR 8080 McCormick Blvd., Skokie, Ill.

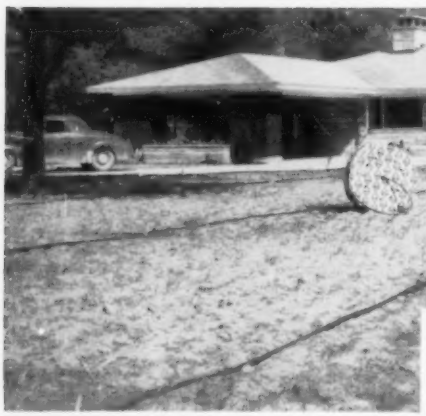
I want more information on B-55G Combustion Control Valves:

- ☐ Descriptive Instruction Sheet
- ☐ Ordering Catalog
- ☐ Please have a qualified representative call

NAME_____
TITLE_____
COMPANY_____
STREET_____
CITY_____ STATE_____

25,000-sq.-ft. sprinkler system of NATIONAL* Polyethylene Pipe installed by 3 men in 2 days





Lines of **National** Polyethylene Pipe laid out, with sprinkler heads installed.

An unending source of water—West Grand Traverse Bay—in the back yard. ▶

IN THIS RESIDENTIAL LAWN SPRINKLER SYSTEM, located in Traverse City, Michigan, are 2,429 feet of USS NATIONAL Polyethylene Pipe in sizes of ¾", 1", 1¼" and 1½". The system includes 105 sprinkler heads, both pop-up and rotary types. Pressure at the heads is 65 pounds; flow rate is 50 gallons per minute.

Installed in just two days, the system covers a lawn area of 25,000 sq. ft. The water is drawn from West Grand Traverse Bay which is adjacent to the property.

USS NATIONAL Polyethylene Pipe is flexible, light, easy to handle, quick to install. Cut it with a knife or hacksaw. Connect it with insert fittings and stainless steel clamps. Acids, salts, alkalis, and other soil chemicals can't harm it. And Polyethylene Pipe remains pliable and workable in temperatures from −90°F. to +120°F. It is made from 100% virgin polyethylene to which 2% of an inert black pigment filler has been added to prevent deterioration from ultraviolet rays.

For full information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Request Bulletin No. 29. *Trademark

This seal of the National Sanitation Foundation means Tested... Approved... Sanitary!

NATIONAL TUBE DIVISION,
UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO,
PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS NATIONAL **Polyethylene** PIPE

UNITED STATES STEEL

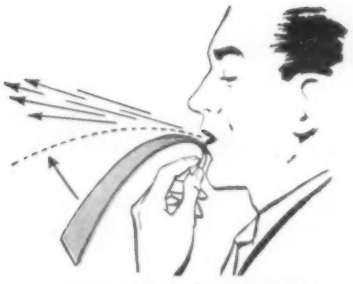
ALL YOU NEED IS A STRIP OF PAPER!

See for yourself

how this unique Sarco TD steam trap operates

...why it's so simple...so trouble-free

...so effective

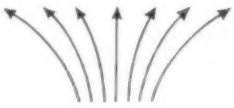


THE PAPER EXPERIMENT

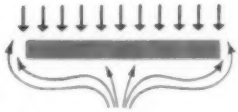
Hold a strip of paper (about 1⅜" wide by 7" long) directly under your lower lip. Blow — creating **low-pressure** area above the paper. It will be forced **upward** by atmospheric pressure, rising to horizontal position!

SO SIMPLE — this is way same principle works in Sarco TD steam trap

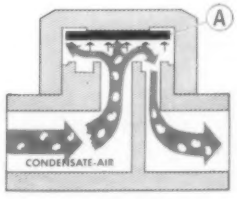
1. Substitute a simple Sarco valve disc for the strip of paper.



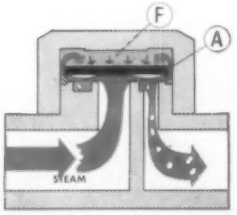
2. Substitute a high velocity jet of steam for the jet of air.



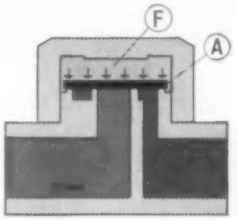
3. Direct steam jet across bottom of Sarco valve disc. This creates **low-pressure** area under disc — resulting in **downward** valve-closing force.



A. Inlet pressure raises disc "A" from seat . . . immediate discharge of air and condensate.

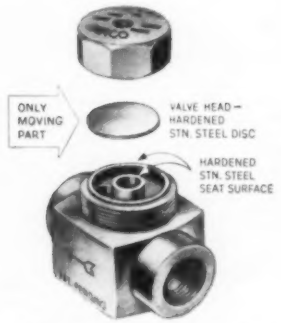


B. Steam follows condensate and the high velocity jet across bottom of disc "A" creates low pressure area (Bernoulli effect) . . . jet is deflected into chamber "F" where it builds up pressure by recompression and this pressure acts on top of disc "A" . . .



C. Pressure in chamber "F", acting on full top area of disc "A", exceeds force of incoming steam and low pressure area under disc . . . and immediately forces it down, closing inlet. As condensation decreases pressure in chamber "F", disc rises and steps **A** or **B** repeat.

No other steam trap like it! The Sarco TD embodies the most important advance in steam trap design in years . . . the thermodynamic principle. Introduced in 1953, the Sarco TD has been thoroughly service-proven. Thousands have been installed ...are providing a level of trapping efficiency and economy heretofore unobtainable.



Small size . . . large capacity

Only 3 parts . . . all stainless steel. Sizes ⅜ to 1"—each body is as small as a tee fitting! Capacity is determined not by a bulky body but by the effective orifice, valve action, pressure drop and condensate temperature.

A FEW OF MANY ADVANTAGES

- *Practically no maintenance* — no valve mechanism, no narrow channels. Trouble-free, simple design.
- *Cuts trap inventory* — one large capacity seat for all pressures . . . for heavy, light or no condensate load.
- *Self-adjusting for pressures 10 to 600 psi* — not a single change or adjustment required.
- *Operates perfectly when pressure fluctuates* — throughout full pressure range.

See for Yourself

We will gladly send you a Sarco TD Steam Trap and strainer for 60-day trial. No cost or obligation. You buy the TD *only* if you're completely satisfied. Advise size — ⅜, ½, ¾ or 1" — and application. Sarco Company, Inc., 635 Madison Ave., New York 22, N. Y.

2205-C

SARCO Thermo-Dynamic STEAM TRAP

THE MODERN TRAP THAT IS MAKING STEAM TRAPPING HISTORY!

you get MORE and MORE to choose from with

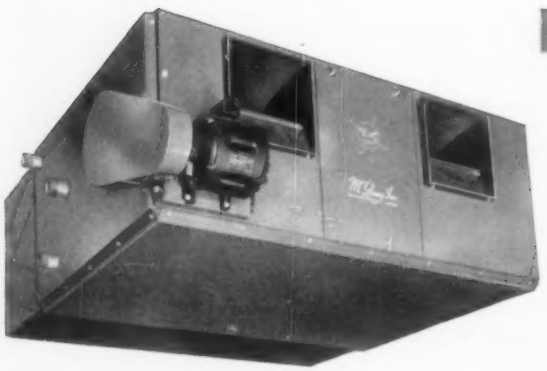
McQuay Seasonmaster central station air conditioners give you more of everything you want, more of everything you need. There is more inherent quality—more dependability—more rugged construction—more flexibility in location of coil connections and air openings—so necessary to that kind of satisfaction that only McQuay Seasonmaster provides. McQuay also gives you more to choose from, with 16 models in either horizontal or vertical type. Add to this the most complete combinations of heating and cooling coils—water, steam or direct expansion—all with the famous McQuay Ripple-Fin construction, and the wide range of accessories, and you have the most universal line of central station air conditioners in the industry. Yes, you really get more—and more to choose from with McQuay Seasonmaster central station air conditioners. For complete information, contact the McQuay representative in or near your city or write McQuay, Inc., 1601 Broadway St. N. E., Minneapolis 13, Minn.

McQuay

SEASONMASTER

central station air conditioners

McQuay Means Quality



McQUAY HORIZONTAL SEASONMASTER

McQuay horizontal Seasonmaster, shown above, with water coil, steam coil and "V" filter section. Removable panels permit complete accessibility for inspection or service. All Seasonmaster coils are made with the exclusive McQuay Ripple-Fin construction.

McQUAY VERTICAL SEASONMASTER

McQuay vertical Seasonmaster, shown above, with direct expansion coil, steam coil, face and by-pass, and flat filter section. Heavy gage galvanized channel framework to form a rigid structure. Sixteen sizes available in either horizontal or vertical type. C.F.M. range from 640 to 29,000.

McQuay INC.

AIR CONDITIONING
HEATING
REFRIGERATION

Sarco offers you this big Plus . . .

Complete Quality Lines of

SARCO RADIATOR VALVES

for steam and hot water

PLUS THE ADVANTAGES OF UNDIVIDED RESPONSIBILITY

. . . for these radiator valves and a wide variety of other steam and hot water heating specialties.

What do you look for in radiator valves? Extra dependability? Long life and easy maintenance? Fine workmanship? You get all of these advantages in Sarco Radiator Valves . . . made to traditional Sarco high quality standards.

No matter what your need . . . there is a Sarco Radiator Valve to meet it. For steam . . . Bellows-Packless, Spring-Packless and Gland-Packed types. For hot water . . . Spring-Packless and Gland-Packed types.

Globe, angle, and corner patterns. Gate type. Modulating and quick-opening. For various pressures up to 150 psi.

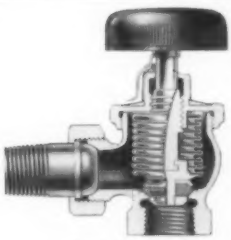
Write for Bulletin 150-B

Contains complete information about these quality radiator valves and their many design and construction advantages.

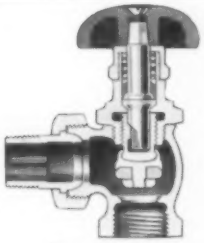
For Sarco Undivided Responsibility—for the convenience and dependability it insures—specify and order from one "Complete Line" source . . . SARCO-SARCOTHERM . . . radiator valves and traps, balancing fittings, and many other heating specialties. Write for bulletins.

SARCO COMPANY, INC.
635 MADISON AVE., NEW YORK 22, N. Y.

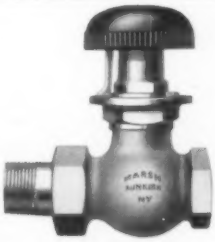
SARCO
AN AFFILIATE OF SARCOTHERM CONTROLS, INC.



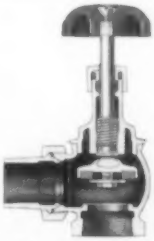
Sarco No. 45
Bellows-Packless Steam Radiator Valve
Modulating Type



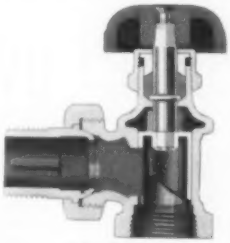
Sarco No. 1141
Spring-Packless Steam Radiator Valve
Quick-Opening Type
(Also, for hot water, No. 1137)



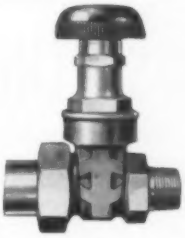
Sarco No. 1247
Spring-Packless Steam Radiator Valve
Modulating Type
(Also, for hot water, No. 1239)



Sarco No. 1126
Gland-Packed Steam Radiator Valve
For 125 psi



Sarco No. 157
Gland-Packed Hot Water Radiator Valve
Sleeve Type



Sarco No. 129
Spring-Packless Convector
Gate Valve

2223-B

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Radiator Valves • Traps

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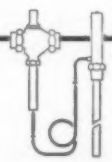
Water Blenders

Air Eliminators



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ACROSS THE NATION BY OVER 400 DISTRIBUTORS

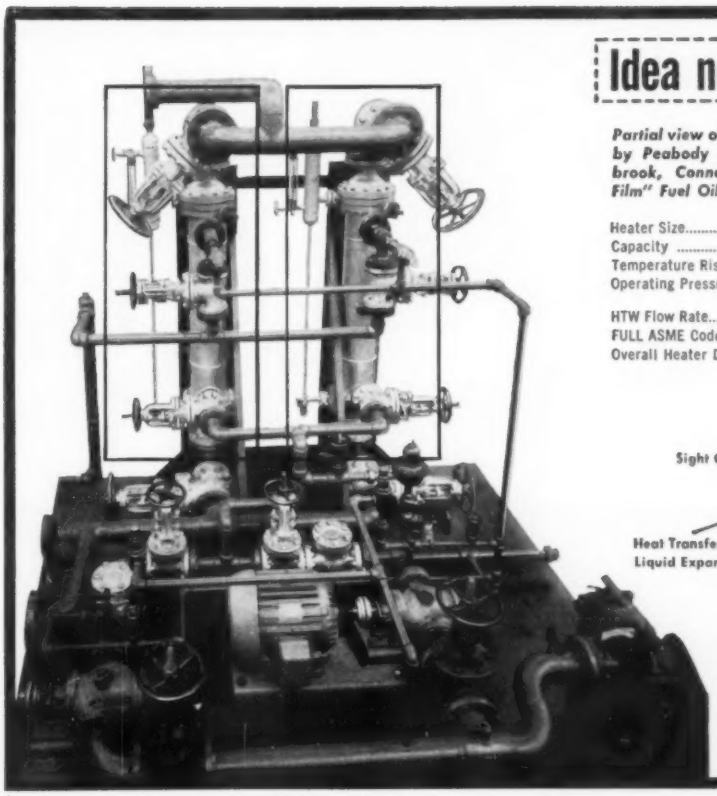
It pays to specify Jones & Laughlin steel pipe for two reasons:

1. You get superior quality pipe. Jones & Laughlin is an integrated steel company. This permits rigid quality control from raw materials through the finishing mills. You can be sure of long-lasting, trouble-free installations with J&L steel pipe.

2. You are sure of a dependable source of supply. J&L pipe is sold by over 400 leading distributors across the nation. They carry complete stocks for prompt service. And they are prepared to furnish technical service by steel pipe specialists.

Whenever you need superior pipe and dependable service, call your nearest J&L distributor or write direct to Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

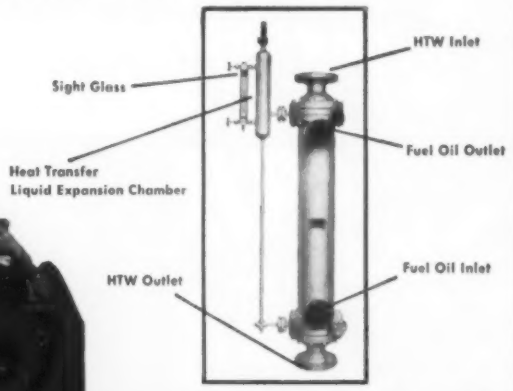
Jones & Laughlin
STEEL
... a great name in steel



Idea no. 2 from Paracoil

Partial view of pump and heater set fabricated by Peabody Engineering Corporation, Glenbrook, Connecticut, utilizing two "Thermo-Film" Fuel Oil Heaters of these specifications:

Heater Size	FF-48 HTW "Thermo-Film"
Capacity	7500 lbs. No. 6 oil per hour
Temperature Rise	80°F to 210°F
Operating Pressures	300 psi, water side 315 psi, oil side
HTW Flow Rate	100 GPM at 370°F
FULL ASME Code Construction	
Overall Heater Dimensions	15" x 6'-6"



How to use High Temperature Water directly in a #6 oil heater...without danger of system contamination!

CUT ALONG DOTTED LINE AND SAVE

The Problem

The pre-heating of #6 fuel oil with High Temperature Water to provide adequate oil temperature and eliminate possibility of leakage of fuel oil into the HTW stream.

Leakage of fuel oil into the HTW stream would result in contamination of the system and could cause serious and costly damage to the boiler and the entire system.

The isolation of the fuel oil heaters can be accomplished by several methods. For example, the HTW stream may be passed through an evaporator to supply steam for use in a steam-type fuel oil heater. Or, the HTW stream may be passed through an intermediate water-to-water exchanger to heat a secondary water stream circulated through a water-type fuel oil heater.

In both of these systems, the HTW stream is safely isolated from the fuel oil heater by an intermediate secondary circuit. But effective as these methods are, they both require a minimum of two heat exchangers, additional space and additional connecting piping, regulators, level controls, etc.

A New Solution

Now for the first time the Paracoil "Thermo-Film" Fuel Oil Heater furnishes the optimum solution to the problem. **In a single exchanger** the "Thermo-Film" Heater provides adequate oil temperature, isolation of the HTW circuit from the oil circuit, a reduction in space requirements, simplicity of operation and substantially lower initial installation cost. A number of double tube elements are enclosed within the heater shell providing three circuits: the primary HTW circuit, an intermediate heat transfer fluid circuit, and the oil circuit.

The heat flow path is from the HTW to the heat transfer fluid to the fuel oil. In the rare event of an oil tube failure, the free oil cannot contaminate the HTW stream as it becomes trapped in the intermediate space containing the heat transfer liquid, and gives warning to the operating personnel by rising in the indicating gauge glass at the expansion chamber.

Your inquiries for Paracoil "Thermo-Film" applications to HTW systems are invited.

DAVIS ENGINEERING CORPORATION

30 Rockefeller Plaza, New York 20, New York • Circle 6-5650

All

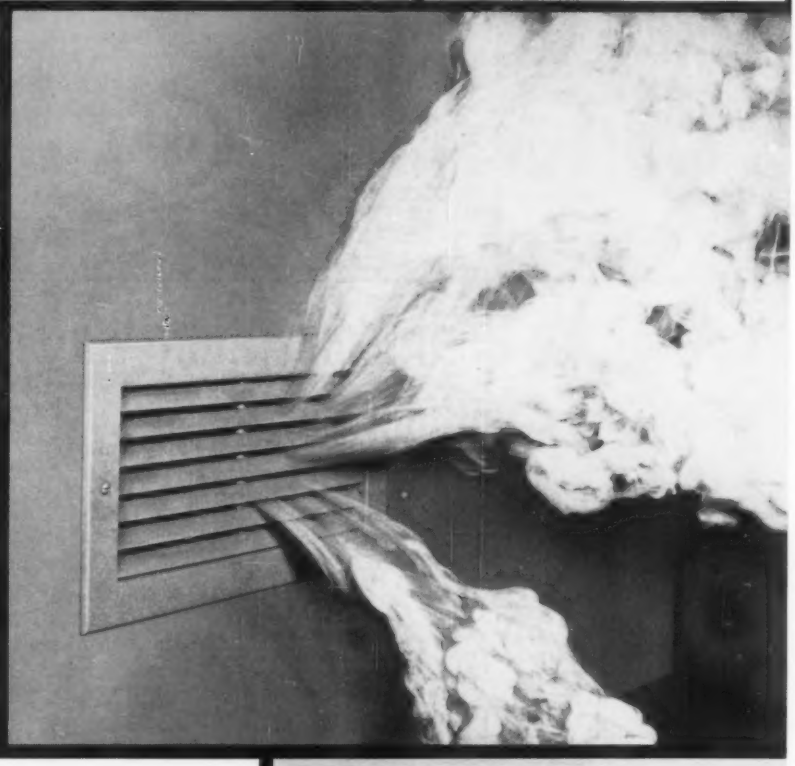
WATERLOO

Registers and Grilles are tested and approved by

ANEMOSTAT® Laboratories

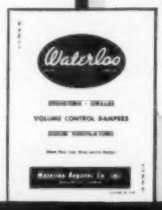
· TESTED · APPROVED · ANEMOSTAT CORPORATION OF AMERICA

This smoke test picture, illustrating the exhausting of room air through Waterloo style 3H Return Air Grille, was taken in the Anemostat Laboratories in Hartford, Connecticut. It is one of a series of tests conducted by Anemostat research engineers to insure maximum efficiency of Waterloo equipment. In installations throughout the country, Waterloo registers and grilles are used with Anemostat air diffusers — a combination that results in top-quality performance.



Waterloo supply registers and grilles feature the exclusive silent flow "tear drop" louvre design. They are manufactured in a modern plant using the most efficient techniques, and every Waterloo unit is backed by 56 years of experience in air conditioning, heating and ventilating applications. ● These, plus Waterloo's wide range line and fast service on specials, are good reasons why it pays to install Waterloo units in your next job.

Write for Waterloo Catalog, containing complete data.



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TO ASSURE YOU THAT AIR MOVING EQUIPMENT...

...will perform according to its published ratings.

An international program is under way by AMCA. It will provide you as rapidly as possible with a means of identifying those types of air moving equipment qualifying under the program.

As a protection to you, practically all leading manufacturers of air moving equipment are planning to qualify their standard products in tests made in accordance with the AMCA Standard Test Code and in laboratories inspected and approved by AMCA.

Each qualifying company will operate under a license agreement with AMCA basically requiring the following:

1. **The manufacturer's laboratory must be approved by AMCA.**
2. **Qualifying equipment must be tested in accordance with the AMCA Standard Test Code and published ratings must be in accordance with such tests.**
3. **The manufacturer must maintain manufacturing control of the products involved so that the equipment will perform in accordance with published ratings.**

For more details fill in and mail the coupon below.

AIR MOVING & CONDITIONING ASSOCIATION, INC.

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AIR MOVING & CONDITIONING ASSOCIATION, INC.
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Please let me have details on the AMCA Program for rating of air moving equipment.

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COMPANY_____

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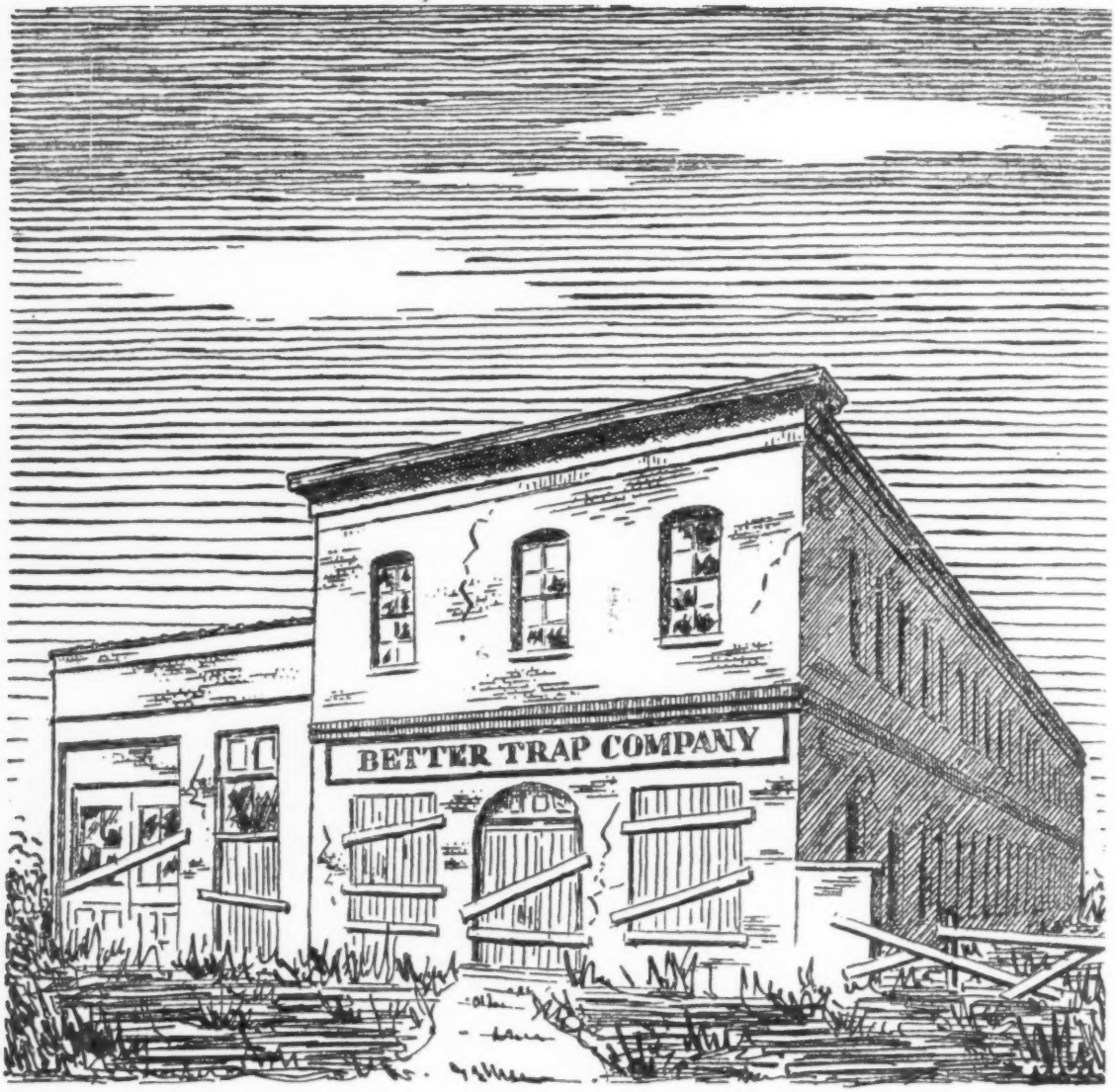

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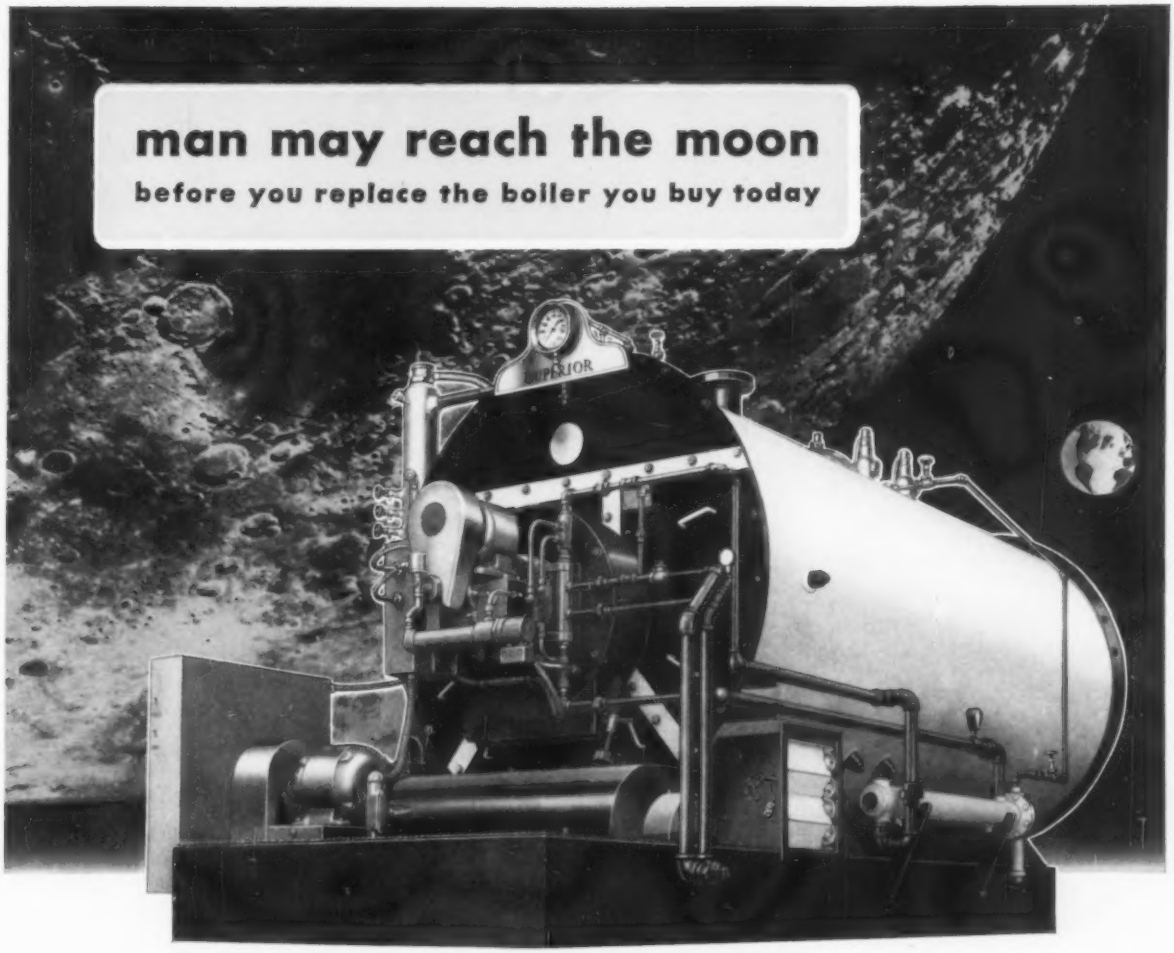
. . . the world *won't* beat a path to the door of the man who builds a better one *and then doesn't advertise it* so that people will know about his product, know where it can be bought and how much it costs.

Advertising benefits the buyer, too. It tells you the product story, makes it easy for you to buy. Even more important to you, advertising leads to mass production and volume sales . . . which means lower costs and lower prices.

Yes, "Advertising Benefits You" . . . 'specially business-paper advertising.



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Superior Steam Generators encompass the most complete line of packaged boilers available. Write for complete details today.
Fire Tube types to 600 b.h.p. (Write for Catalog 904 F).
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Man will reach the moon . . . tomorrow perhaps . . . but more than likely "tomorrow" in the dictionary of scientists means 20 years . . . and that's a long time to pay the penalty of high steam costs. A boiler is a long term investment; and the equipment you buy today determines your steam costs for years to come.

Superior Steam Generators are designed and built to last longer, and to operate at higher efficiencies throughout their entire serviceable life. Evidence of this you can see for yourself in Superior's bigger, heavier construction and completely integrated design. Superior Steam Generators provide more steam per dollar over a longer serviceable life.

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SUPERIOR
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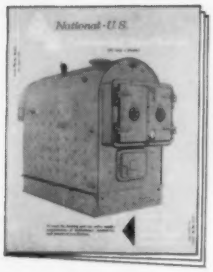
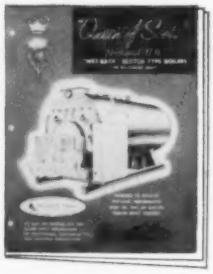
Is Your Literature File *Complete*

on these Heating and Air Conditioning Products?



Commercial Steel Boilers

Available in sixteen sizes with SBI net ratings ranging from 2,500 to 35,000 sq. ft. of steam radiation and from 4,000 to 56,000 sq. ft. of water radiation. For oil or gas, or for hand or stoker firing. Also supplies ample hot water for all purposes. **Form No. 700**



"Wet-Back" Scotch Type Steel Boilers

Available for natural and forced draft in thirteen sizes with net ratings ranging from 4,500 to 50,000 sq. ft. of steam radiation and 7,200 to 80,000 sq. ft. of water radiation. For oil or gas firing. Wide range of storage type and tankless water heaters available. **Form No. 819A**

"66" Series Cast Iron Gas Boiler

Available in twenty sizes with IBR net ratings ranging from 1,770 to 14,250 sq. ft. of steam radiation and from 3,005 to 22,775 sq. ft. of hot water radiation. A.G.A. approved for all types of fuel gases. **Form No. 718A**

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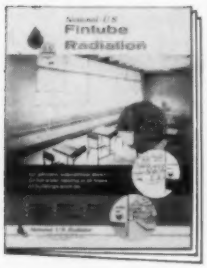

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Available with steel and non-ferrous finned heating elements with a wide variety of enclosures. Accessories available include standard and expansion roller brackets, ceiling hangers, splicers, corners, access panels and dampers. **Form No. 864A**

Capitolaire Commercial and Industrial Air Conditioning

A complete line of air conditioning equipment: central station packages, free-standing commercial packages—air cooled, water cooled or evaporative condenser types; also air handling equipment and fan-coil units. **Form No. AC-785A**

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National-U.S. Radiator
CORPORATION
HEATING AND AIR CONDITIONING DIVISION
Johnstown, Pennsylvania

ACCO
for Better
Values

R-P&C VALVES

THE COMPLETE LINE
—DESIGNED FOR DEPENDABILITY

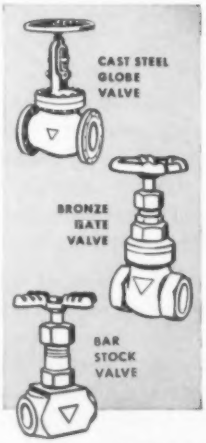
Created by R-P&C—made and sold exclusively by R-P&C...Electric Furnace Iron Valves

Electric furnace iron—introduced exclusively in R-P&C Valves—provides a high quality cast iron that meets the exacting requirements for pressure castings. Melted and refined under closest metallurgical supervision, R-P&C Electric Iron has physical properties *far exceeding the minimum standards* to which they must conform. It has a balanced chemical composition and a tough, dense body structure; and, it is more resistant to corrosion. All cast iron parts of R-P&C Valves are made of this Electric Furnace Iron.

Shown above is **Fig. 625**, a general service valve which is particularly applicable where full, unobstructed flow is desired. This type, available in bronze-trimmed or all-iron style, either flanged or screwed, is made in fifteen sizes, from 2″ to 24″—and is typical of the better values offered by the entire line of R-P&C Electric Iron Valves.

The R-P&C Line is Complete

The R-P&C line embraces gate, globe, angle and check valves in bronze, electric furnace iron and cast steel, and forged steel; all in a wide range of sizes, styles and pressure classes. Also, R-P&C offers specialties such as Lubrotite gate valves, bar stock valves, asbestos-packed cocks, cast steel fittings and pressure-seal cast steel valves. Order through your nearby R-P&C Distributor. For complete catalog, write our Reading office.



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Installation pointers, operating tips, clues to longer valve life. They are all on this 22″ x 17″ wall chart. Write for your free copy.

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Another new development using

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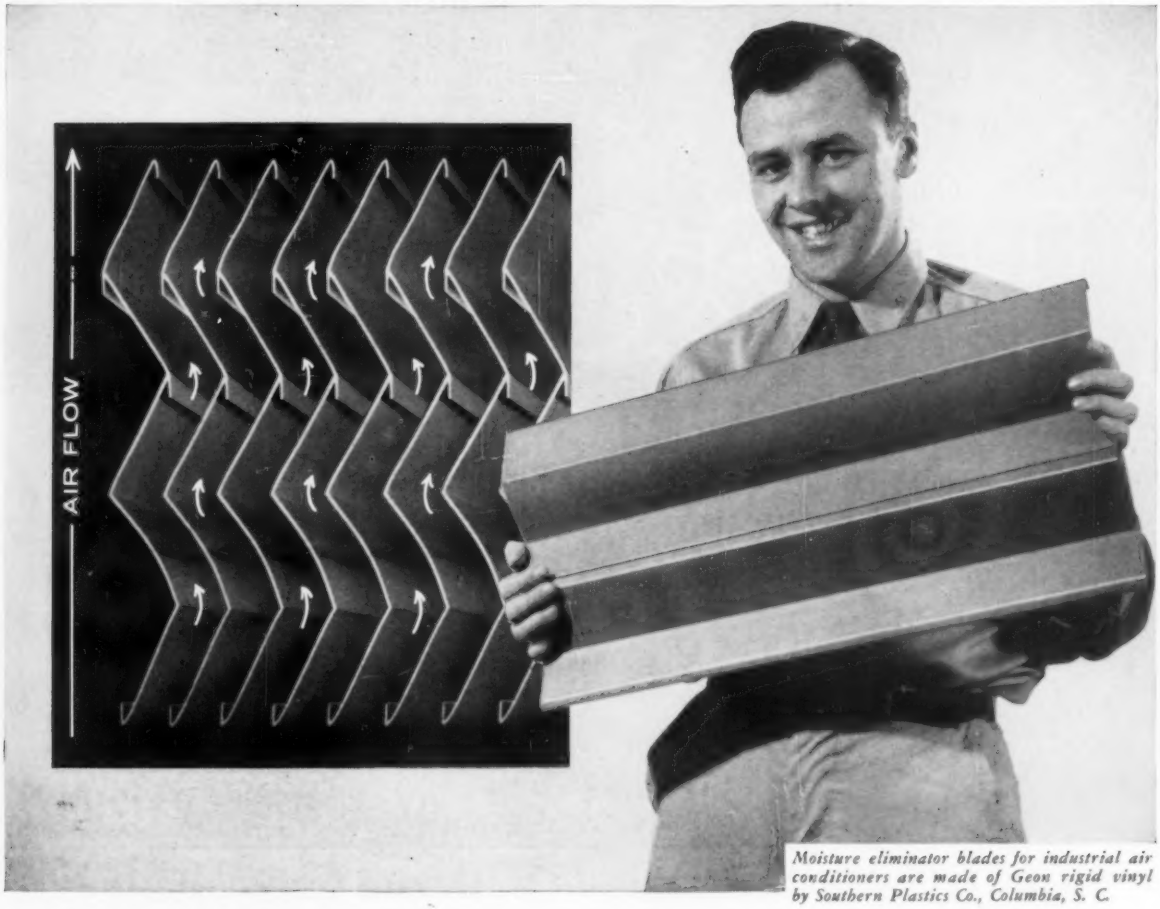

Moisture eliminator blades for industrial air conditioners are made of Geon rigid vinyl by Southern Plastics Co., Columbia, S. C.

blades of Geon keep air dry...end replacement problems

THESE moisture eliminator blades for industrial air conditioners are now made of Geon rigid polyvinyl chloride compound — to end frequent replacement of formed sheet metal blades.

Parts made of Geon rigid vinyl won't corrode. They are economical, easy to clean and extremely durable... meet flameproof requirements. Air-carried corrosive materials have no destructive effects on these blades because Geon has exceptional resistance to acids, alkalies and other chemicals.

Geon polyvinyl resins and plastics are unique raw materials. Their outstanding physical, chemical and electrical properties have opened markets for many new products—rigid piping, wire insulation, flexible wall covering, foam padding, coatings for textiles, metal and paper.

For further information on Geon write Dept. FL-6, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

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A "snap" to install . . . all parts snap or fit together. Low first cost . . . low installation cost.

BFOT is a slimmer, more stylish baseboard . . . ideal for wall-to-wall carpeting . . . permits "zone" heating . . . so designed that any cold air from picture windows actually improves heat circulation . . . easily painted to blend with any color scheme . . . no deep air foils to run up painting costs.

You'll want to know more about America's Newest Baseboard. Write for "BFOT" data.

MOVING INTO AIR CONDITIONING? The nearby Dunham-Bush sales engineer can be a big help to you. He's readily available to review the complete Dunham-Bush line of air conditioning and refrigeration products. Your request will bring him your way.

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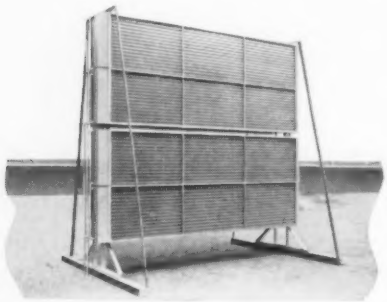
UNICON

GETS BIGGER and BIGGER

There is only one answer to large capacity condenser problems — the KRAMER UNICON. Every day more engineers plan larger tonnage installations — 50, 100 and even — 800 tons. And every day UNICONS are shipped to all parts of the world for giant-sized installations. No other air-cooled condenser can match the long, successful record of UNICON, backed by thousands of applications since 1937 — in the widest range of tonnages and climatic conditions. Your condensing problems can be best answered by use of the best — the KRAMER UNICON.



Space-saver UNICON, *as illustrated,* serves a 60-Ton air conditioning system, yet takes but 70 sq. ft. of roof space.

UNICON is a remote-type air-cooled condenser that requires no water. KRAMER UNICON can be used with any size compressor, REGARDLESS of horsepower. Any size refrigeration or air conditioning system can be air-cooled with UNICON, REGARDLESS of tonnage. UNICON requires less horsepower, less piping, is easier to install and costs less. KRAMER UNICON performs best — even in semi-tropical climates.

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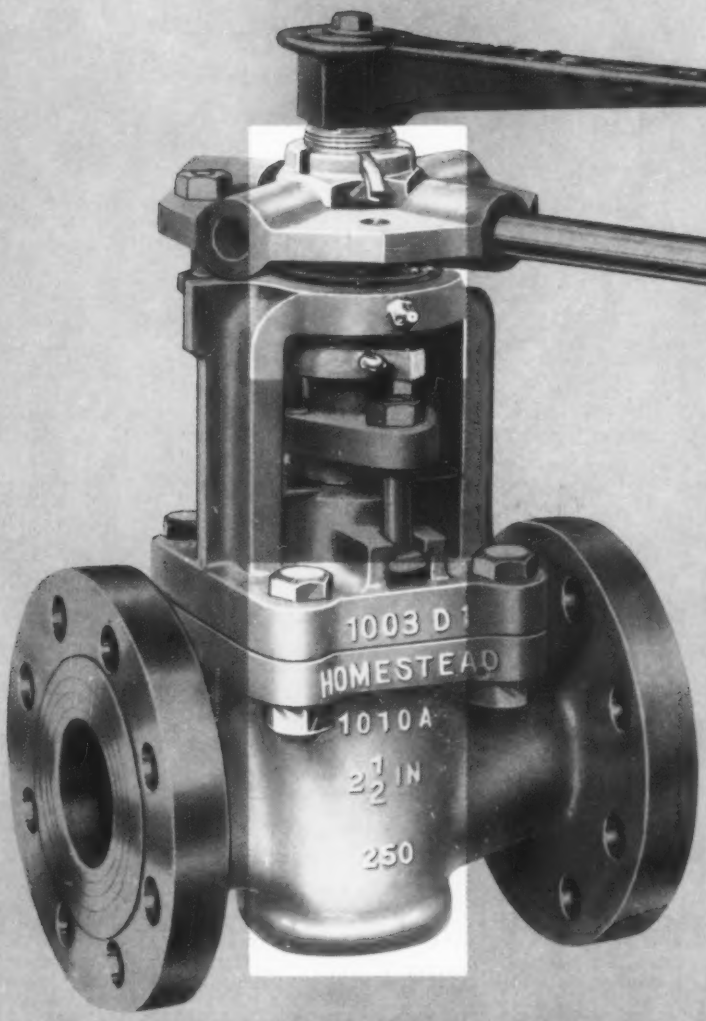
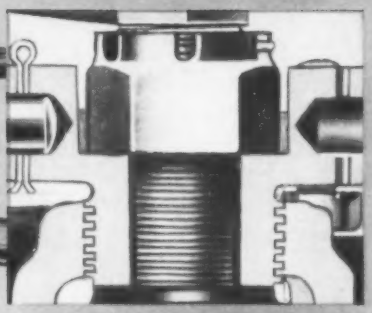
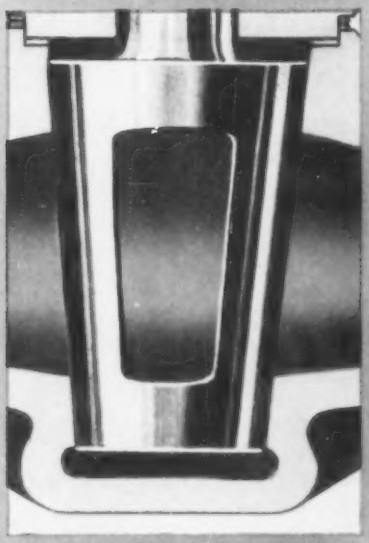
In the spots that count... Homestead® Valves are

STICK-PROOF





Built-in lever and screw affords instant operation



Seating pressure is mechanically relieved for easy turning

TROUBLE-FREE SERVICE is assured under all fluid, temperature and pressure conditions by the exclusive design of Homestead Lever-Seald Valves.

Instant stick-proof operation is guaranteed by a built-in lever and screw which mechanically relieves seating pressure. This controlled relief of pressure is only sufficient to overcome friction and to permit the plug to turn freely. What's more, all operating parts are protected from the damaging effects of corrosive or erosive service conditions and are completely weatherproof.

Write today for fully detailed Reference Book 39—Section 3. See for yourself how Homestead Lever-Seald Valves can solve your problems on high temperature, pressure or corrosive services.

h
v

HOMESTEAD VALVE MANUFACTURING COMPANY
P. O. Box 128 • Coraopolis, Pa.

Here's How KENNEDY'S Union Bonnet and Hex End Design Give You Easier Installation, Longer Valve Life...

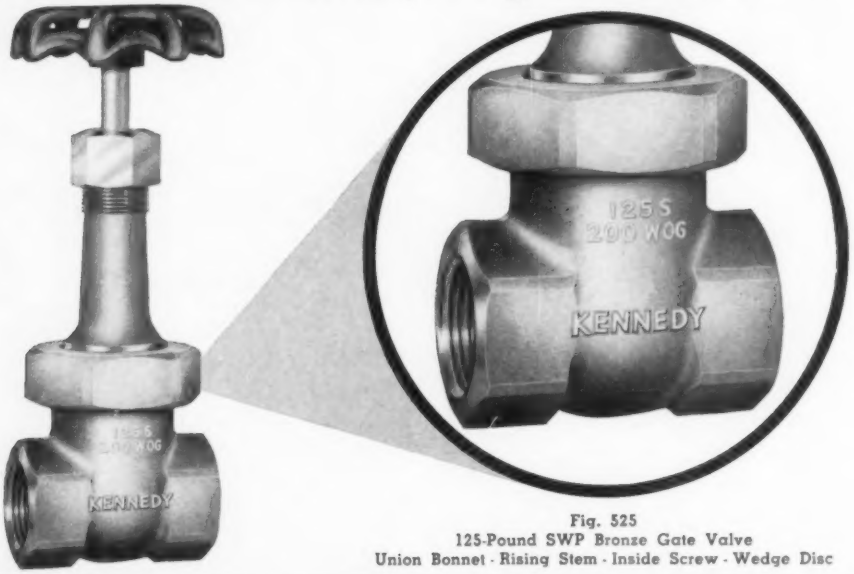
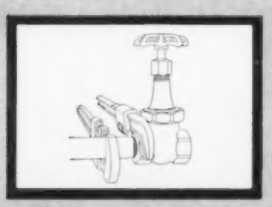
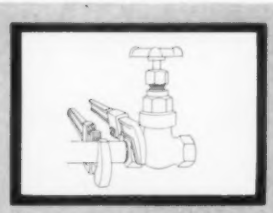


Fig. 525

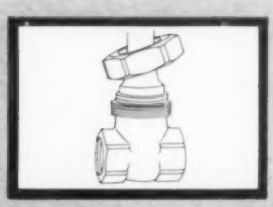
Fig. 525
125-Pound SWP Bronze Gate Valve
Union Bonnet - Rising Stem - Inside Screw - Wedge Disc



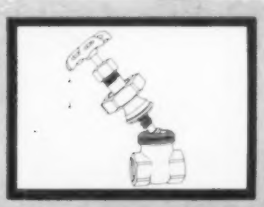
KENNEDY'S wider hex ends are blended into the body, making the body and hexes one rugged unit. Thus extreme wrench pressure is absorbed through the entire rigid valve body.



On conventional valve body, hex ends protrude from the body and are connected by thin body wrists. This area, under severe wrench pressure, can distort and cause disc seating trouble.



Kennedy's Union Bonnet permits repeated dismantling for cleaning or inspection and reassembly without danger of distortion to the valve. The bronze-to-bronze construction makes a tight union for tight, leak-proof operation.



Union Bonnet Fig. 525 can be easily disassembled into its component parts to installation in otherwise inaccessable places in existing lines or in new installations where space is limited.

These additional advantages make KENNEDY your best valve buy ...

Heavy Bronze Union Bonnet Ring is entirely separate from the bonnet to eliminate any possibility of springing the bonnet face when assembling or disassembling the valve.

Cylindrical Body withstands sudden pressure. Kennedy's Cylindrical Body construction resists rupture and minimizes deflection when under severe pressure. Pressure in ordinary valve bodies tries to push the body wall out. Rupturing stresses concentrate where wall has the shortest radius. This deflection causes early failure in ordinary valves.

• *YOU CAN'T BUY A BETTER VALVE THAN A KENNEDY!*

KENNEDY VALVE MFG. CO.

1607 EAST WATER ST., ELMIRA, NEW YORK

VALVES • PIPE FITTINGS • FIRE HYDRANTS

• OFFICES AND WAREHOUSES IN NEW YORK, CHICAGO, SEATTLE, SAN FRANCISCO, ATLANTA • SALES REPRESENTATIVES IN PRINCIPAL CITIES •

Buffalo "PC" horizontal suspended cabinet has conditioned air for close quality control at a precision ball bearing plant. Requires little attention, no floor space. Buffalo "VPC" vertical floor mounted cabinet at right with back cover removed.

SUSPENDED . . . OR VERTICAL

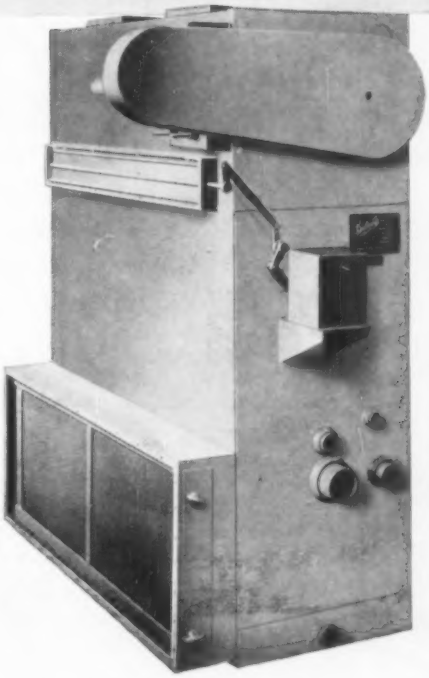
"BUFFALO" AIR CONDITIONING CABINETS GIVE YOU UNEQUALLED EASE OF INSTALLATION, SPACE ECONOMY AND DEPENDABILITY

Whether your plans call for a suspended central conditioning cabinet or a floor unit, "Buffalo" design works for you all the way:

SIMPLIFIED "KNOCK-DOWN" CONSTRUCTION not only permits ease in moving thru standard building openings but simplifies maintenance — permits ordering "custom" units (with or without coils, or as "heat now — air condition later" units) in a compact "package".

SATISFACTION IN USE, thanks to "Q" Factor* engineering and construction as shown at right. "PC" Cabinets are serving dependably in leading hospitals, office buildings, plants and schools. Write for Bulletin AC-120 for details on these practical, reliable units.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*



BUFFALO FORGE COMPANY

BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

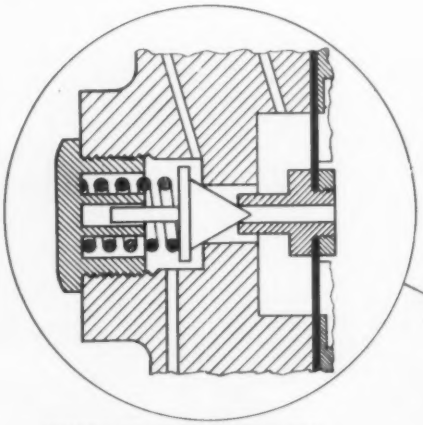
VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

TO PNEUMATIC OPERATORS

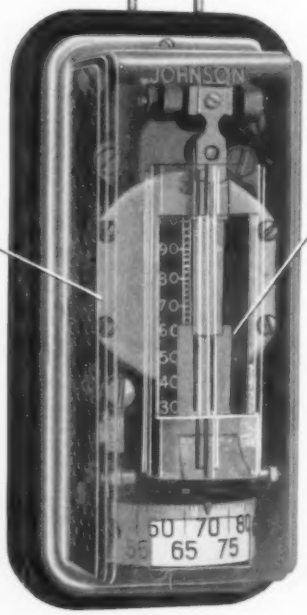
AIR PIPING. Is unaffected by short circuits, capacitance, inductance, temperature, relative humidity; it need not be placed in conduits or insulated.

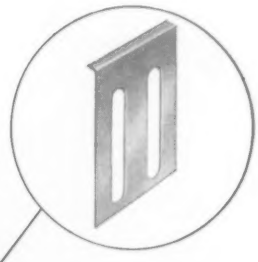
CONTROL PRESSURE GAUGES
May be located as desired to observe operation of the system.

FROM AIR COMPRESSOR



SIMPLE VALVE MECHANISM
The heart of the Johnson Thermostat.





MEASURING ELEMENT
Low-mass, bi-metal temperature measuring element is capable of *any required sensitivity.* What could be simpler?

TYPICAL JOHNSON PNEUMATIC ROOM THERMOSTAT
No additional amplifiers, relays or other remotely located auxiliary components are needed. It's all here in one compact unit under the cover. Johnson thermostats for measuring temperatures and pressures in ducts, pipes, etc., and controllers for relative humidity are equally simple.

INSURE SYSTEM-WIDE SIMPLICITY

For All Types of Industrial and Commercial Applications—Air Conditioning • Heating • Cooling • Ventilating • Humidifying • Dehumidifying • Processing

The basic components of Johnson Pneumatic Control, shown above, reveal how remarkably simple and free from complication the best control systems can be.

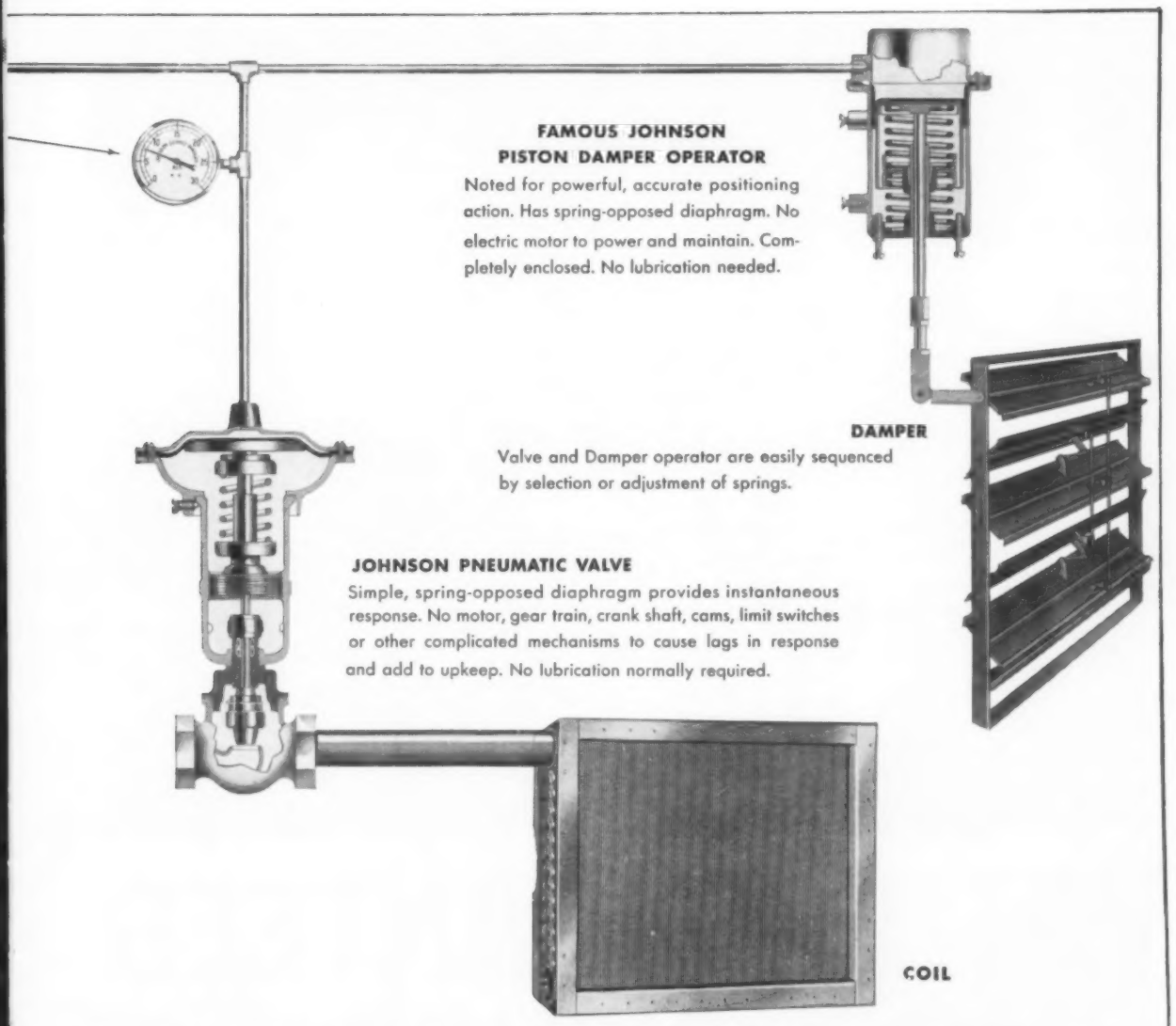
The Johnson Room Thermostat—the world's most accepted thermostat—is a refined reducing valve in a compressed air line, set and reset automatically by an accurate bi-metal temperature measuring element, to transmit compressed air, at varying pressures, to valves, dampers and other devices.

Johnson Diaphragm Valves and Damper Operators are equally simple devices with flexible, long-life diaphragms which are moved as the thermostat transmits changes in air pressure. Only pneumatic control gives you system-wide simplicity.

The widespread use of pneumatic power by other industries offers further evidence of its simplicity and adaptability. Examples include truck and train brake systems, industrial power tools, hoists, bus suspension systems, lubricating equipment, machine tools and countless others.

Compare *systems* carefully. You'll discover that Johnson pneumatic apparatus is simpler by far and that you can do control work with just a fraction of the components that would otherwise be required.

JOHNSON CONTROL
PNEUMATIC SYSTEMS
DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885



FAMOUS JOHNSON PISTON DAMPER OPERATOR

Noted for powerful, accurate positioning action. Has spring-opposed diaphragm. No electric motor to power and maintain. Completely enclosed. No lubrication needed.

DAMPER

Valve and Damper operator are easily sequenced by selection or adjustment of springs.

JOHNSON PNEUMATIC VALVE

Simple, spring-opposed diaphragm provides instantaneous response. No motor, gear train, crank shaft, cams, limit switches or other complicated mechanisms to cause lags in response and add to upkeep. No lubrication normally required.

COIL

WITH JOHNSON PNEUMATIC CONTROL

YOU'LL BE BETTER SATISFIED with PNEUMATIC BECAUSE TODAY'S PNEUMATIC CONTROL

- *Has fewer components per system.*
- *Is highly accurate, dependable—has fewer components subject to failure.*
- *Is easier to operate—easier, less costly to maintain.*
- *Offers the widest choice of compensating, sequencing and other operating features.*
- *Provides the necessary flexibility to solve even the most intricate control problems.*
- *Is completely safe under all conditions.*

Let Johnson demonstrate how the advantages of pneumatic control can be applied to your specific problems. Use the coupon or call in a nearby Johnson engineer. No obligation, of course.

WIDEST EQUIPMENT SELECTION

Johnson makes the most complete line of pneumatic control equipment for solving any problem of temperature, humidity or pressure control. Equipment includes thermostats, recorder-controllers, valves, dampers, damper operators, pressure regulators, humidostats, humidifiers, thermometers, switches, special controllers and related apparatus.

Complete engineering, sales and service facilities are available through 104 direct branch offices in the United States and Canada.

JOHNSON SERVICE COMPANY

507-8 East Michigan Street, Milwaukee 1, Wisconsin

☐ Please have a Johnson engineer call on me.

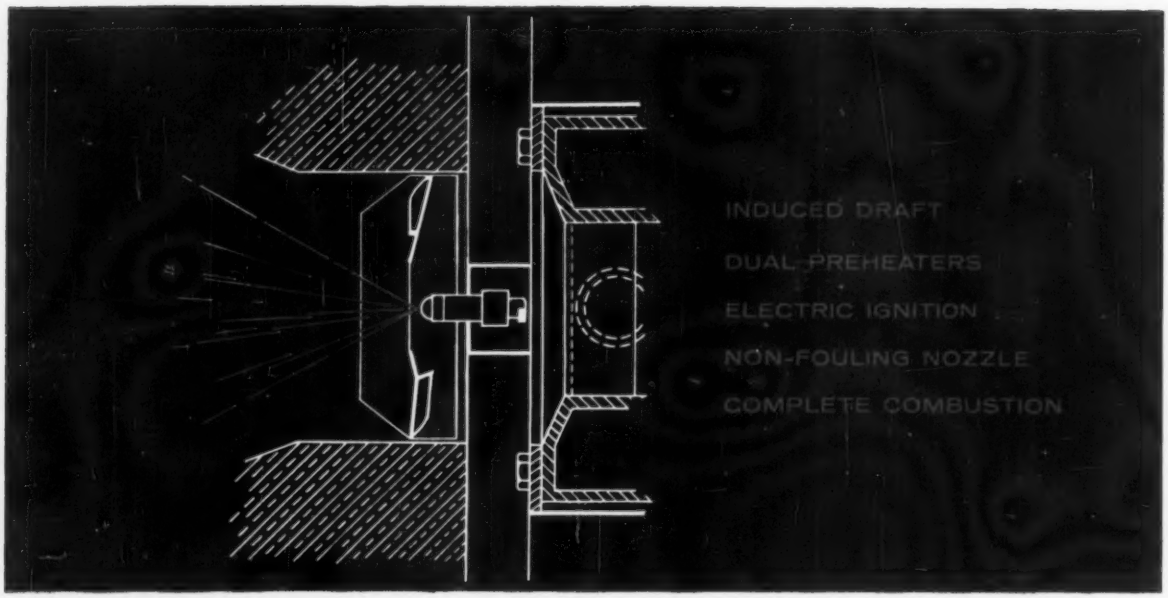
☐ Send your condensed catalog of Johnson equipment.

Name_____ Title_____

Firm_____

Address_____

City & State_____



NEW PYROJET BURNS NO. 5 OIL WITH GUARANTEED EFFICIENCY

If your facilities are designed for No. 5 oil, Dravo's new *Counterflo* Space Heater with PYROJET burner will handle all grades of No. 5 oil efficiently and dependably. The dual pre-heating system brings hot oil out to the tip of the nozzle. Simplified electric ignition system provides smooth, dependable starts. With burner efficiency guaranteed for all grades of No. 5, a new level of heating economy is available.

Dravo Space Heaters with induced draft PYROJET burner are also available in gas or gas/light oil burning models. New stainless steel air-foil combustion chamber raises heat transfer efficiency. Ask your Dravo representative for expert advice on your heating problem, or write Dravo Corporation, Dravo Building, Pittsburgh 22, Pa.

DRAVO

CORPORATION

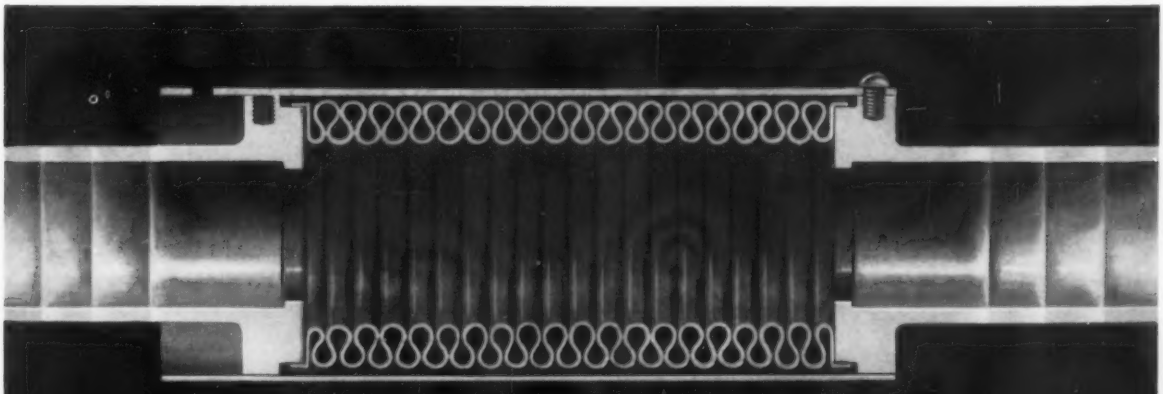
GET ALL THE FACTS ON LOW COST HEATING—WRITE FOR BULLETIN 564 . . .

DRAVO

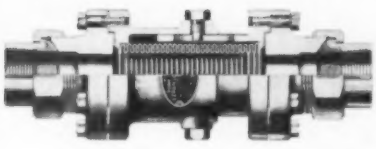
Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

ABSORB PIPE LINE EXPANSION

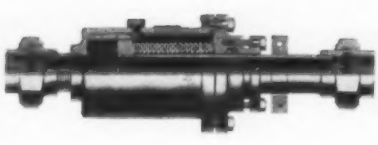
this trouble-free way



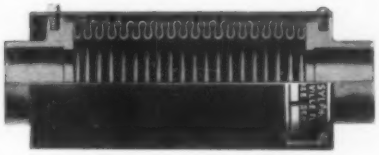
In absorbing the linear movement of steam and water lines, no method is more fool-proof and economical than the Fulton Sylphon Packless Expansion Joint. These Joints minimize installation and construction costs, eliminate packing maintenance, and maintain vacuum for economical heating. The reason is their exclusive Sylphon® bellows. With its two-ply *seamless* construction, this bellows gives utmost protection against leakage . . . Produced by cold-working, it also has greater resiliency for years of "stretching and squeezing."



STEAM LINES No. 110-M Packless Expansion Joint absorbs expansion up to 1¼" in horizontal or vertical lines. Bellows made of Monel for extra strength and corrosion-resistance. Sizes 1" through 3". Steam or water pressures up to 100 psig. for some sizes.



WATER LINES No. 111-M Packless Expansion Joint allows for 1¼" expansion or contraction in hot water or chilled water lines. Features strong, corrosion-resistant Monel bellows plus emergency packing. Pressures to 100 psig, sizes ¾" through 3".



STEAM OR WATER No. 96066 is simple, compact. Absorbs expansion of "baseboard" radiation, finned connectors, horizontal or vertical supply lines, etc. ½" expansion capacity. Maximum pressure 40 psig, copper pipe sizes ¾" through 2".

Mr Controls

Robertshaw-Fulton

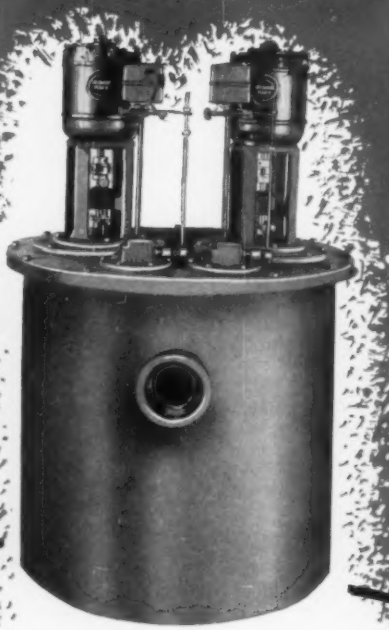
CONTROLS COMPANY

FULTON SYLPHON DIVISION

Knoxville 1, Tenn.

Skidmore

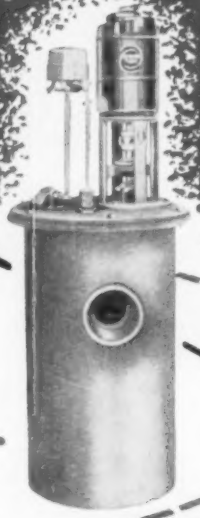
. . . the PUMP that offers CUSTOM DESIGN — at a "standard price"



Built to match your exacting conditions . . . inexpensive to install . . . inexpensive to operate . . . inexpensive to maintain.

There's a Skidmore Heating Pump for that unusual condition—for that below level return—for that low return system or low and high pressure requirements. Advance design and engineering principles built into every Skidmore Pump will give "year-ahead" dependability and trouble free service on every job.

duplex unit



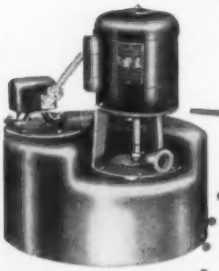
single unit

"UV" CONDENSATE PUMP

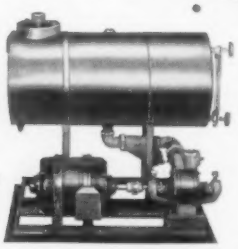
Compact, vertical type pump . . . consists of motor unit and float switch mechanism bolted to sump type receiver. Designed for below floor level return.

Capacities—2,000 to 40,000 EDR.
Pressures—10 to 75 lbs.

SEND FOR BULLETIN No. 19-A



TYPE "CVS" CONDENSATE Capacities — 500 to 10,000 EDR. Pressures — 10 to 40 lbs.



TYPE "TM" TURBINE. Capacities — boilers up to 250 H.P. Pressures up to 150 lbs.

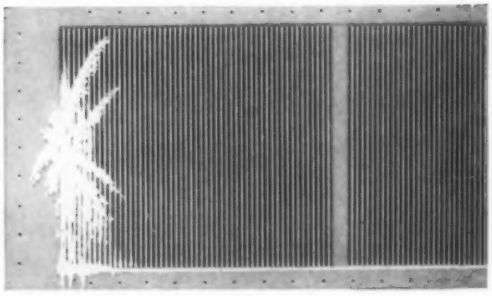
There's a Skidmore Pump built for every heating requirement.

SKIDMORE PUMPS

SKIDMORE CORPORATION

ST. JOSEPH, MICH.

Will it freeze?

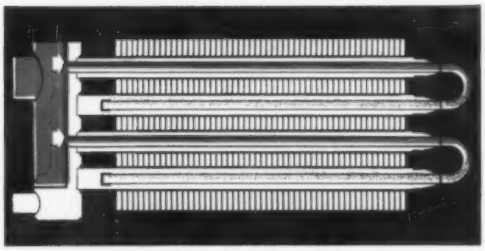


Freeze-ups are the biggest headache in heating and air conditioning. Steam condensate exposed to sub-freezing air . . . trapped water in poorly drained surface . . . bursted tubes . . . system shutdowns . . . irate customers . . . and the service costs that eat up profits—these things shouldn't happen to you!

And they won't—if you use Nesbitt Heating and Cooling Surfaces and observe the precautions made easy by the inherent protective features.

You get built-in protection with Nesbitt Heating & Cooling Surfaces

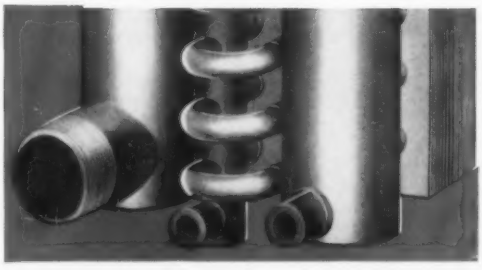
For full details of this exclusive surface, ask for Publication 305



Each trombone steam-distributing tube serves two adjacent condensing tubes from a single supply-header connection. Steam must travel across the first leg of the trombone tube (full length of surface) before reversing, under demand, to serve the second leg. Results: uniform discharge temperatures, controllability, and freeze protection *under all modulation.*

Series T Heating Surface with Trombone Steam-Distributing Tubes

The story of Water Surface is told in Publication 246



To overcome the difficulty of water-draining in continuous-tube cooling surface, Nesbitt pitches its Series W Surface within the casing and incorporates its exclusive drain headers to relieve trapped bends. The drain feature is also embodied in cleanable-tube surface. No premium is charged for this safety precaution which can save you many dollars of grief.

Series W Water Surface with Pitched Coils and Drainable Feature

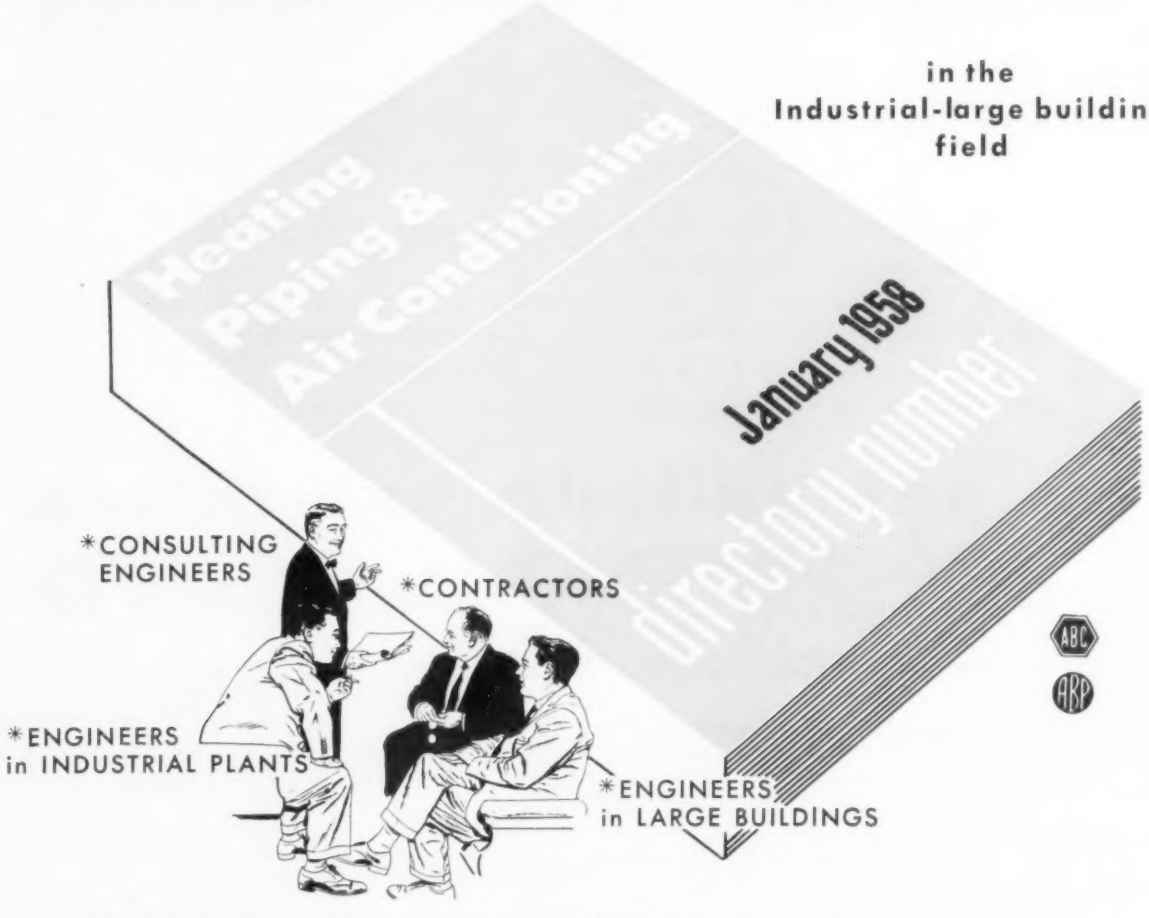
If you have been plagued with freeze-up problems, contact your nearest Nesbitt Representative and let him explain these inherent protective features.

MADE AND SOLD BY JOHN J. NESBITT, INC., PHILADELPHIA 36, PA.

JANUARY DIRECTORY ISSUE

...the center of attention for those who count

in the
Industrial-large building
field



Here's where they* go when looking for sources of supply. The January Directory Issue of HEATING, PIPING & AIR CONDITIONING.

How can you be sure? Well, just ask your customers and prospects as we did. 9 out of every 10 of our subscribers (all paid – ABC) report they use this issue when specifying and buying – in many cases as often as every week.

On the right you'll see why. Full of up-to-date, authoritative material, HP & AC's January Directory is the only complete, field-specialized Buyers' Guide to this market.

It makes sense to make capital of such an opportunity. Go "all out." Show your complete line, introduce your 1958 program with a flourish, list your reps, wholesalers, or branch offices. In short, play this issue for all its substantial worth. There's no better place for EXTRA effort – a spread, multiple pages, an insert.

Regular rates apply . . . . . December 10 closing date

Contains

An alphabetical listing of all products used in this field, and manufacturers of each.

•

Names and addresses of all the manufacturers.

•

A listing of all known trade names, cross-referenced.

•

A guide to the products advertised in this issue and the manufacturers' names.

•

Normal editorial content of a regular issue – including the official Journal of the ASHAE – plus valuable reference data sheets.

Heating, Piping & Air Conditioning

KEENEY PUBLISHING CO. AIR CONDITIONING HEADQUARTERS

6 N. Michigan, Chicago

Schnacke HAS LED THE INDUSTRY — others have Followed!

was 1st IN QUALITY — IN LOW PRICE AND NEW DEVELOPMENTS — with

INTERCHANGEABLE PARTS FOR COMPLETE HIGH & LOW TEMPERATURE COMPRESSOR LINE

Same sleeves, pistons, valves, rods, seals, all wearing parts are used in all compressors, 5 HP to 75 HP, reducing manufacturing costs. Only line having these features.

ADVANCE ENGINEERING FOR HIGHER SPEEDS OVER 11 YEARS AGO

Schnacke pioneered higher speeds with new design compressors — with square bore and stroke, dynamic balance — insert type bearings — automotive design, etc. which made possible lower prices.

REFRIGERANT – COOLED REPLACEABLE SLEEVES

Suction gas is drawn through ports in block around sleeves, providing extra cooling effect — are slip fit and replaceable with modern suction valves and one piece discharge valve assembly with liquid relief spring.

THERMATROL CAPACITY CONTROL

Maintains constant evaporator temperatures without cylinder unloading, unbalancing compressor or over heating. Simple trouble free suction modulating device proven successful in practical use for 10 years.

COMPLETE PACKAGE WATER CHILLER LARGE CAPACITY 10 to 250 TONS

Completely factory designed and assembled liquid chiller with all refrigerant piping, wiring, starters, controls, eliminating field labor and usual installation hazards.

DUAL TEMPERATURE PACKAGE STANDARD CHILLER WITH BOILER

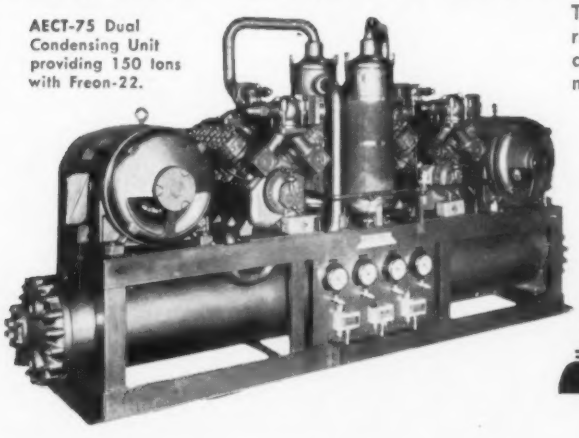
Liquid chiller and attached boiler for heating and cooling — still exclusive with Schnacke. Capacities from 10 tons to 30 tons cooling. Provides selection of boiler.

BLOW THROUGH PROPELLER TYPE COOLING TOWER

First successful blow-through propeller cooling tower, requires less horsepower and provides dry fan and motor — and lowest prices in the industry.

A MODERN DESIGNED COMPRESSOR — PLUS LOW PRICES

Schnacke proved that it could be done profitably. Schnacke has set the price standard — others have followed with lower prices.



AECT-75 Dual Condensing Unit providing 150 tons with Freon-22.

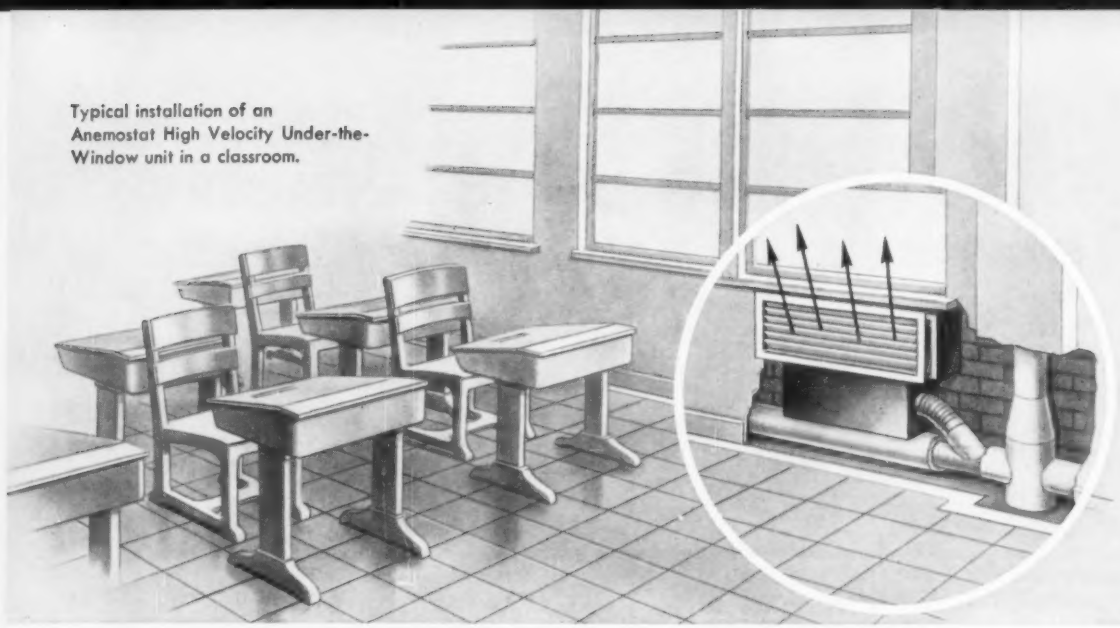
The trend of the industry in engineering design in recent years, has proven Schnacke leadership in advance engineering — in higher quality — in manufacturing advantages.

Schnacke will continue to set the pace for high quality equipment, improved design, and manufacturing methods, and low prices.

From a Consulting Engineer's letter — "The most rugged compressor when the going is really rough."

SCHNACKE, INC.

Evansville 7, Indiana



Typical installation of an Anemostat High Velocity Under-the-Window unit in a classroom.

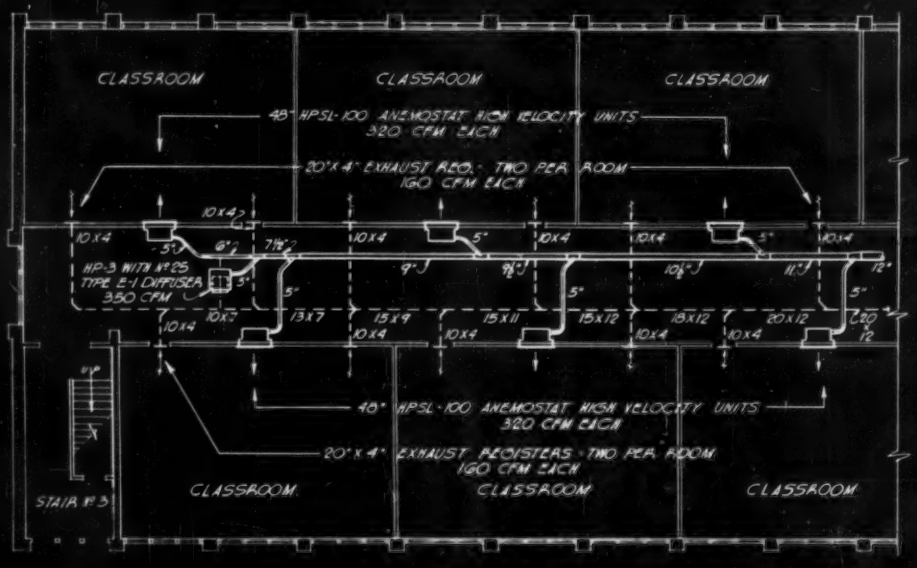
How to deliver
high velocity air to schoolrooms

Shown here are two ways of using the Anemostat All-Air High Velocity system of draftless air distribution for heating and ventilating schools. Under-the-Window units (above) are the most practical for colder climates. Corridor distribution (below) is preferable in warmer climates.

Advantages:

- All-Air High Velocity units require smaller than conventional ducts, thus save space and money.
- All-Air HV units can be used for individual or zone control, in single or dual duct installation.
- Since air is supplied from the main equipment room, there is no need to break through the outside of the building for prime air make-up. This eliminates grilles, dampers, possibility of leaks.
- The Anemostat All-Air HV system can be simply installed by the sheet metal trades. No supply or return pipes are required. Units are quiet, need a minimum of maintenance from custodians.

For latest data on All-Air High Velocity units, write on your business letterhead for new Selection Manual 60 to Anemostat Corporation of America, 10 E. 39 Street, New York 16, N. Y.



Diagrammatic layout shows corridor distribution of high velocity air for wing of school.

Air Conditioning, Ordering, Installing,
Maintaining – Now Made Easier For You . . .

SATISFABRICATED by GOVERNAIR

Yes! SATISFABRICATED! ©

It's our way of telling the world that Governair Products are guaranteed to satisfy the widest range, the most exacting capacities, and the most truly unusual space requirements.

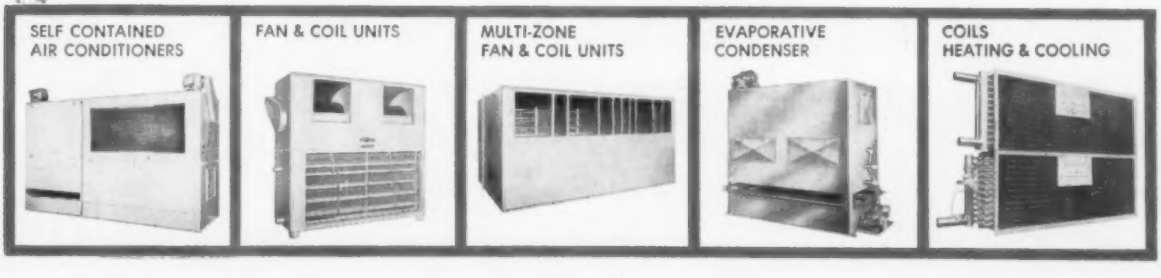
Governair offers a SPECIAL saving of time and trouble with its complete line of Self-Contained Units. They're easier to order, since you specify only one unit in place of picking several components. Easier to install, too, since they are delivered fully tested and ready to operate with simple electrical, water and duct connections.

Best of all, Governair's quality engineering and construction assure you of lower cost maintenance so important to the purchaser.

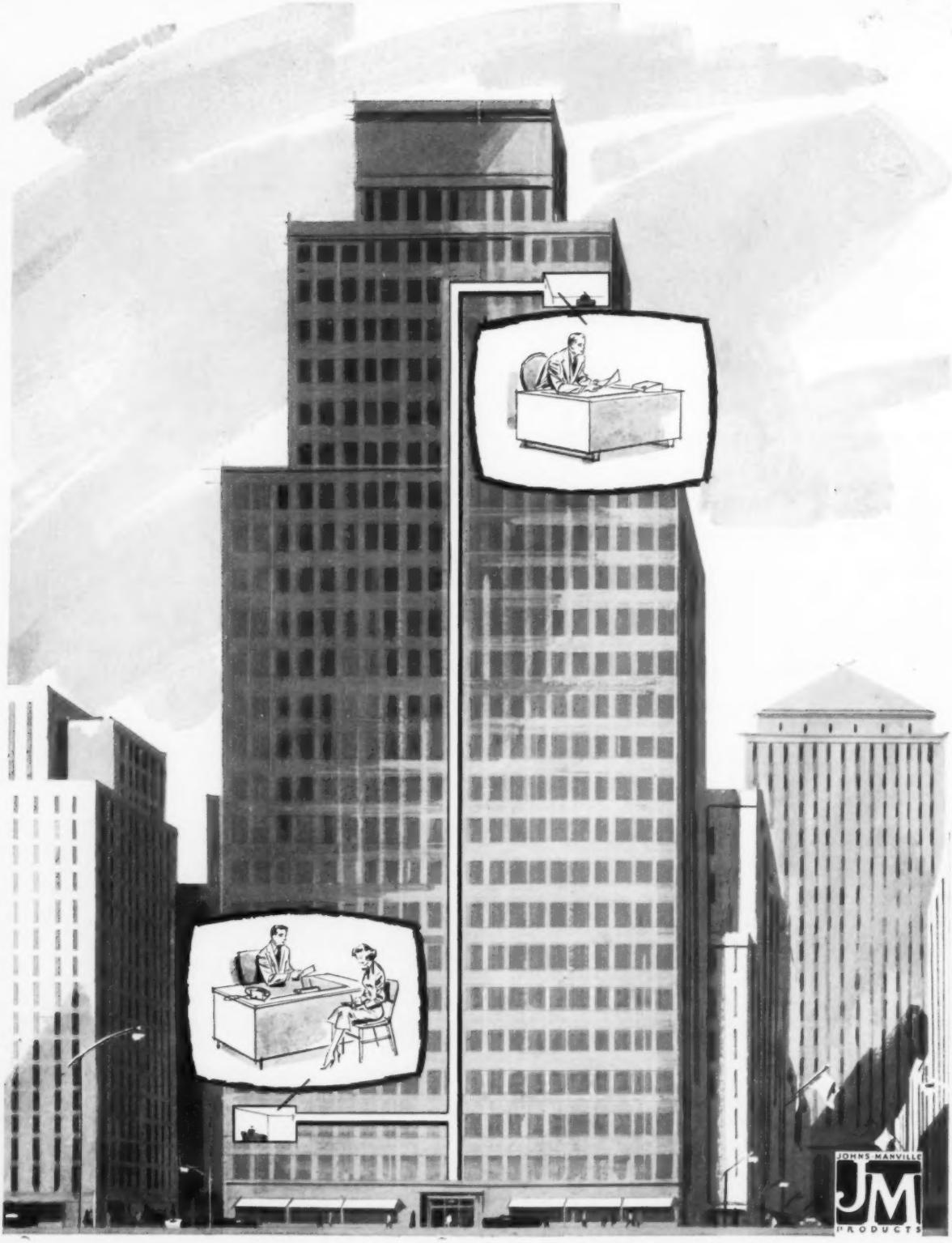
WRITE OR CALL FOR DETAILED INFORMATION.

GOVERNAIR CORPORATION
4840 NORTH SEWELL
OKLAHOMA CITY, OKLA.

GOVERNAIR



Mr. Smith is 600 duct feet farther from



the fan room than Mr. Jones, yet . . .

both men work comfortably at the same temperature!

when ducts are *fitted square and tight* with Johns-Manville semi-rigid Spintex Insulation

SEMI-RIGID SPINTEX® works two ways to lessen heat loss, stop condensation: first, with low conductivity . . . then, with its square, tight fit. The structural strength of this material, which is fastened snugly to duct surfaces with pins and clips, prevents "ballooning" due to duct leakage. And butted or mitred joints eliminate stretching and thinning of the insulation at corners. Instead, there's a full thickness of Spintex—with full protection against heat loss and condensation—over the *entire duct area.*

This two-way "edge" in insulating effectiveness is the big reason why leading architects everywhere specify semi-rigid Spintex . . . for factories, institutions and office buildings of every description.

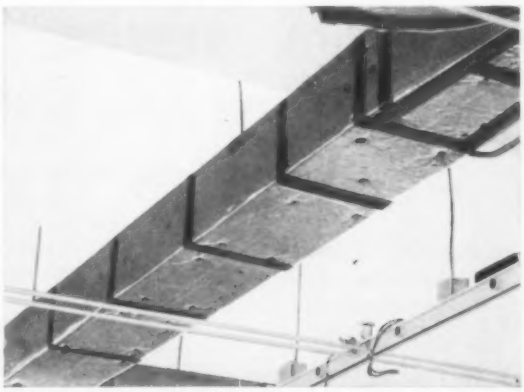
Produced by a new Johns-Manville spinning process, today's Spintex offers more insulating value than ever. Its mineral fibers are smaller in diameter, and substantially more uniform. This improved fibrous structure adds countless heat-blocking dead-air spaces per cubic inch to help keep working temperatures precisely the same throughout the structure . . . with minimum operating costs!

Your Johns-Manville sales representative will be pleased to send you information, along with samples of Spintex and J-M facing materials. Why not call him today. Or write Johns-Manville, Box 14, New York 16, N. Y. In Canada, 565 Lakeshore Road East, Port Credit, Ontario.

LESS HEAT LOSS...NO CONDENSATION AT CORNERS!
Semi-rigid (not flexible) Spintex fits squarely and tightly all duct surfaces. Stretching and thinning at corners, unavoidable with wrap-around insulations, are eliminated completely. Instead, Spintex retains full thickness everywhere to stop heat loss and condensation. Its structural strength prevents "ballooning."

FACED FOR ANY SPECIALIZED NEED!
J-M offers you a facing to meet any vapor condition, incombustibility requirement or decorative need. Provides good base for plaster finish . . . or where no facing is indicated, Spintex presents an attractive appearance with trim, tidy joints.

INSTALLS QUICKLY . . . ECONOMICALLY.
Spintex is clean, sanitary and "friendly" to handle. It cuts readily with an ordinary knife. Installs quickly, easily, even when ducts are curved or in difficult-to-reach areas.



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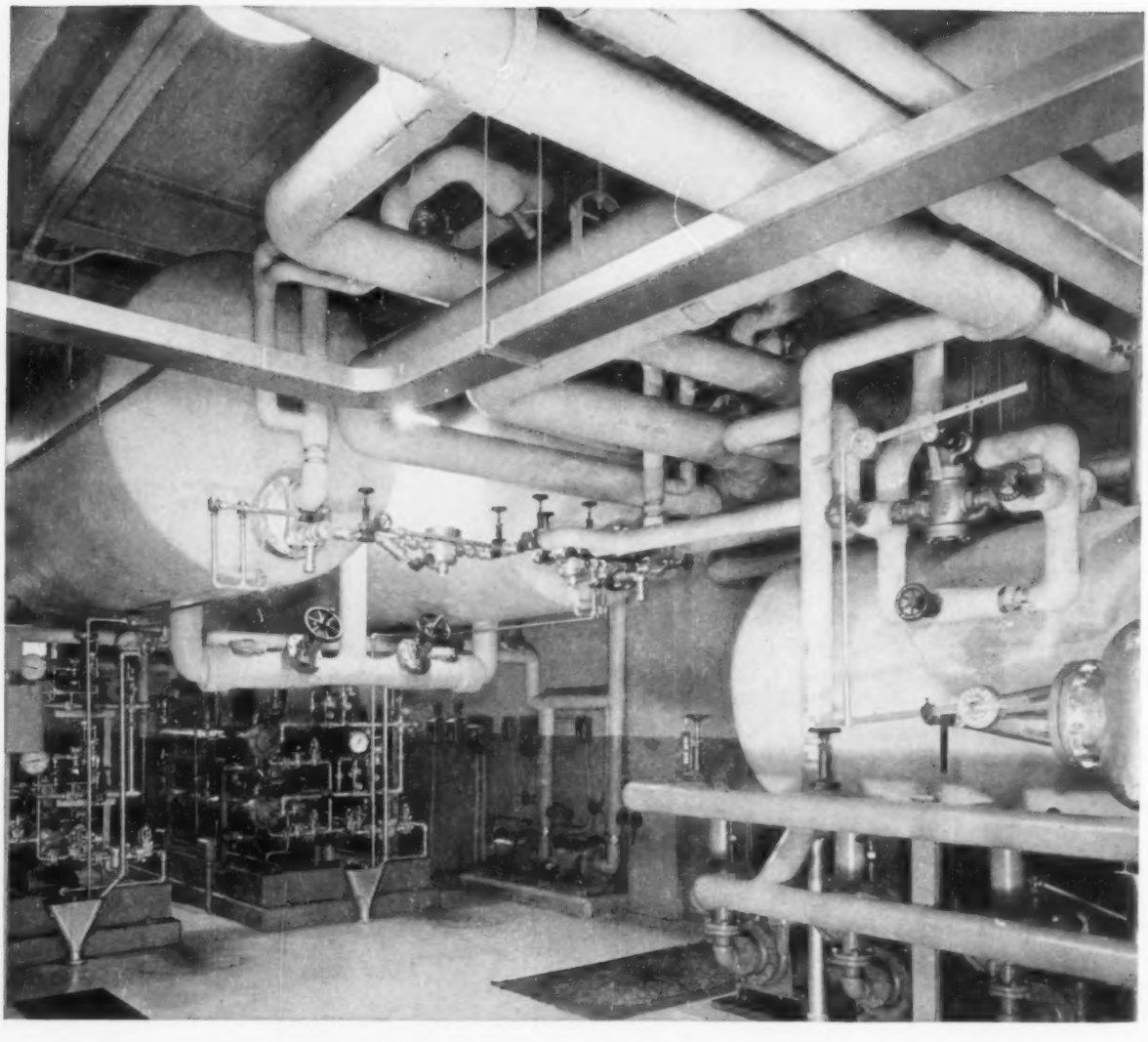


K&M HIGH-PRESSURE INSULATIONS WITHSTAND VIBRATION AND TEMPERATURE CHANGES!

Minimize Fuel Costs As Long As The Equipment Lasts!

You get more heat from every fuel dollar. With K&M High-Pressure Insulation, your fuel costs remain low . . . your process control more precise. Even severe operating conditions can't interfere with its insulation efficiency.

K&M High-Pressure Insulations meet every need. For temperatures up to 1900°F., use K&M Hy-Temp Combination—diatomaceous silica overlaid with K&M "Featherweight" 85% Magnesia. Staggered joints prevent heat loss through expansion-caused openings. For temperatures up to 1350°F., use K&M Kaytherm—hydrous calcium silicate bonded with asbestos fibers—important for power and petroleum applications. For temperatures up to 600°F., use K&M "Featherweight" 85% Magnesia—a basic carbonate of magnesia mixed with asbestos fibers. K&M High-Pressure Insulations come in a variety of sizes and thicknesses . . . in pipe and block insulation.

Write today to us for more information.

K·M
BEST IN ASBESTOS

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

When piping changes direction, protect process equipment with

ZALLEA SELF EQUALIZING UNIVERSAL EXPANSION JOINTS

Zallea Self Equalizing Universal Expansion Joints absorb any movement in any direction . . . axially, laterally, angularly, or any combination of these . . . making them ideal for protecting process vessels and rotating equipment from thermal expansion of connected piping.

When there is a leg or 90° offset to a long run of pipe, one Zallea Universal Expansion Joint will frequently take care of the entire system.

Under conditions of low load requirement for anchors or equipment . . . or when compressive loading in pipe walls must be kept to a minimum . . . Zallea Universal Expansion Joints are the most economical answer to the problem. They absorb the internal pressure thrust. The piping system need only carry the relatively small deflection loads.

Many types of Zallea Tied Expansion Joints are designed especially to absorb lateral deflection or rotation when there is pressure in the line. Universal, Modified Universal, Hinged, Gimbal, Pressure Balanced and Universal Pressure Balanced Expansion Joints give you a choice of the type best suited to your particular application.

Get the complete story of Zallea Expansion Joints in our new 72-page manual. Write, on your company letterhead, for your copy of Catalog 56. Zallea Brothers, 816 Locust Street, Wilmington 99, Delaware.

Zallea
expansion joints

Zallea Brothers • Wilmington 99, Delaware

World's largest manufacturer of expansion joints

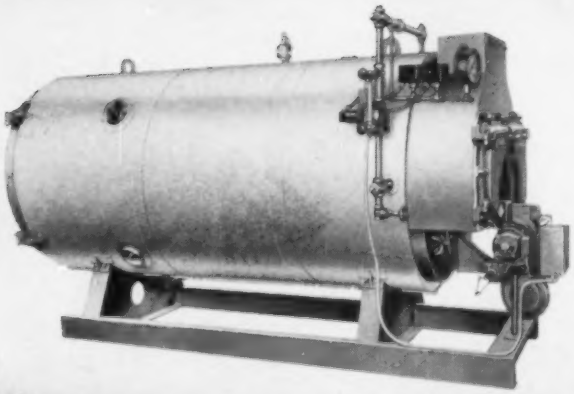
24" dia. Zallea Universal Self Equalizing Expansion Joints in service lines of the engine test facility of a West Coast aircraft manufacturer.

NEW!

18 TO 92 HORSEPOWER

FORCED-DRAFT

NEW 606,000 TO 3,060,000 BTUH CAPACITIES: Forced-draft package teams low pressure Kewanee Scottie Jr. Boiler with Iron-Fireman Micro-Mist Oil Burner. Exclusive burner principle completely atomizes and carburets No. 5 or lighter fuel oil before combustion.



KEWANEE®-IRON FIREMAN

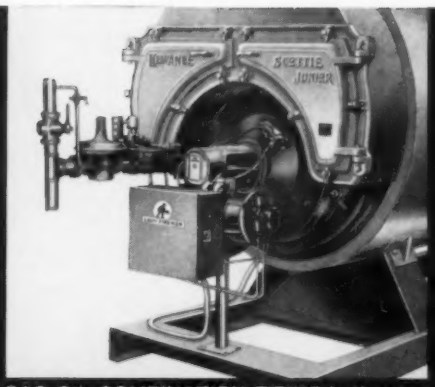
Now . . . 8 popular sizes are available in both high pressure and low pressure models.

Forced-draft firing keeps combustion air supply constant, regardless of location or atmospheric conditions. Vent pipe only is needed—eliminating added cost and unsightliness of a stack.

Fuel flexibility is offered by proved burners built on exclusive principles to completely carburet either light or heavy oils. Gas and gas-oil combination units are also available.

Kewanee factory-assembles the entire unit before shipping. Boiler is fitted with burner and controls at factory. Fire-tested if desired. Package is shipped complete—or if job conditions require, the burner may be field mounted at a later date.

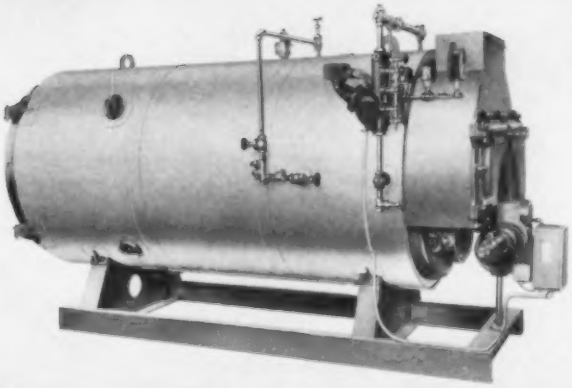
The coupon at right brings complete information. Mail it today to your nearby Kewanee Man, or to: AMERICAN-STANDARD, KEWANEE BOILER DIVISION, 101 Franklin Street, Kewanee, Illinois.

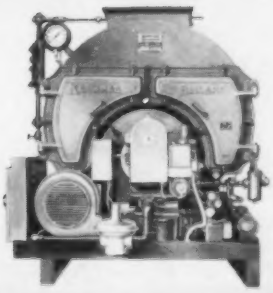


GAS-OIL COMBINATION FIRING in the new Kewanee-Iron Fireman package series is provided by the Iron Fireman Model C-240-GO Combination Gas-Oil Burner, with simple valve control for fuel changeover.

PACKAGE UNITS

NEW 18 TO 92 HP CAPACITIES: Forced-draft package combines all-welded high pressure Kewanee Scottie Jr. Boiler with matching Iron-Fireman C-240 high pressure Oil Burner—with exclusive Whirl-Blast combustion—for No. 2 oil or lighter. Provides 125-150 swp...high temperature water above 250° F.





OTHER LARGER KEWANEE-IRON FIREMAN FORCED-DRAFT BOILER-BURNER UNITS range up to 651 hp for high pressure . . . 21,855,000 Btuh for low pressure. For No. 6 or lighter fuel oil, gas and gas-oil combination firing.

American-Standard
KEWANEE BOILER DIVISION
101 Franklin Street • Kewanee, Illinois

Please supply literature on the following Kewanee-Iron Fireman Forced-Draft Package Units:

- ☐ low pressure
- ☐ high pressure
- ☐ new 18 to 92 h.p. units only
- ☐ all capacities

Name_____

Firm_____

Street_____

City_____ State_____

AMERICAN-Standard
KEWANEE BOILER DIVISION

EFFECT OF INTEGRAL FINNED TUBE ON HEAT TRANSFER PERFORMANCES

In addition to pioneering in the development of integrally-finned condenser tube, Wolverine Tube has also been responsible for coining the various designations used to describe different types of integrally finned tubing. Because of the increasing popularity of Wolverine Trufin®, we are often asked to explain just what these designations mean.

Actually, Wolverine Trufin is available in six different types—each designed for use in specific heat transfer applications. The most widely used is Trufin Type S/T named by Wolverine to identify its use in shell and tube condensers. Trufin Type S/T is a low finned tube with either 16 or 19 fins per inch (depending on alloy). The ratio of outside-to-inside surface area is approximately 3.75 to 1.

Wolverine also produces Trufin Type W/H, so named because it was designed primarily for use in water heaters. Trufin Type W/H is a high finned tube with 11 fins per inch. It has an outside-to-inside surface ratio of approximately 4.75 to 1.

To help the processing industry do a better hydrocarbon cooling job Wolverine developed an all-aluminum Trufin tube with integral fins on the outside and longitudinal fins on the inside. This tube is called Trufin Type I/L (internal longitudinal). It is available with 5, 7, 9, or 11 fins on the outside and has sufficient fins on the inside to approximately double the surface area. In addition to hydrocarbon cooling, Trufin Type I/L is also ideal for air cooling oil or in air-type refrigeration evaporators.

Trufin Type L/C is a high finned-lightweight aluminum tube mechanically bonded to an interior liner of any metal. Type L/C was designed to economically provide an extended surface tube with a liner core permitting adaptation to a variety of corrosion and/or pressure requirements. Type L/C, too, is ideal for air-cooled operations.

To facilitate insert type end connections by brazing, Wolverine developed an extended surface tubing with a controlled inside diameter—named it Trufin Type H/A (high area). Trufin Type H/A is a high finned tube with an outside-to-inside surface ratio of approximately 8:1. Air or gas flows outside the tube to be heated or cooled. The heating or cooling liquid is passed through the inside of the tube.

Finally there's Trufin Type H/R (high root)—similar to Type H/A. The root diameter is closely controlled and sufficient wall thickness allowed to permit the removal of fins for rolling into tube sheets. Type H/R is a high finned tube—has an outside-to-inside surface ratio of approximately 8:1.

And there, briefly, is a look into the background of integrally finned condenser tubing—a Wolverine development that is becoming more and more important with the passing of each day.

LOOK

FINS actually

E-X-T-R-U-D-E-D

from the tube wall!

The fact that its fins are part of the tube wall is the secret of the construction of Wolverine Trufin. It's the secret too, of the amazing performance records which Trufin-tubed heat exchange units are hanging up every day.

Because the fins and tube are all one piece, you are assured of constant efficiency. Fins are not impaired by vibration, temperature change or varying pressure. Trufin transfers *more* BTU's per foot of tube—permits you to design more compact units—steps up the capacity of existing ones.

Trufin is fabricated as easily as plain tube, too. In fact, standard tools and techniques are used. Fabricated Trufin units are often stronger than units using plain tube because fins provide additional support at bends. Remember: You can *depend* on Trufin for *dependable* heat transfer!

WRITE FOR CATALOG

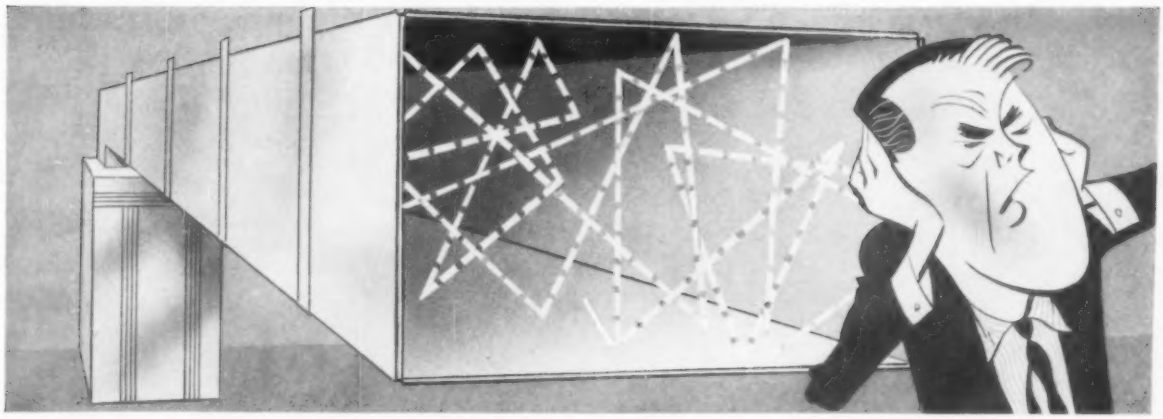
BUY WOLVERINE TUBE—IT'S MADE IN AMERICA

CALUMET & HECLA, INC.
CALUMET DIVISION
WOLVERINE TUBE DIVISION
FOREST INDUSTRIES DIVISION
CALUMET & HECLA OF CANADA LIMITED
CANADA VULCANIZER AND EQUIPMENT COMPANY LIMITED

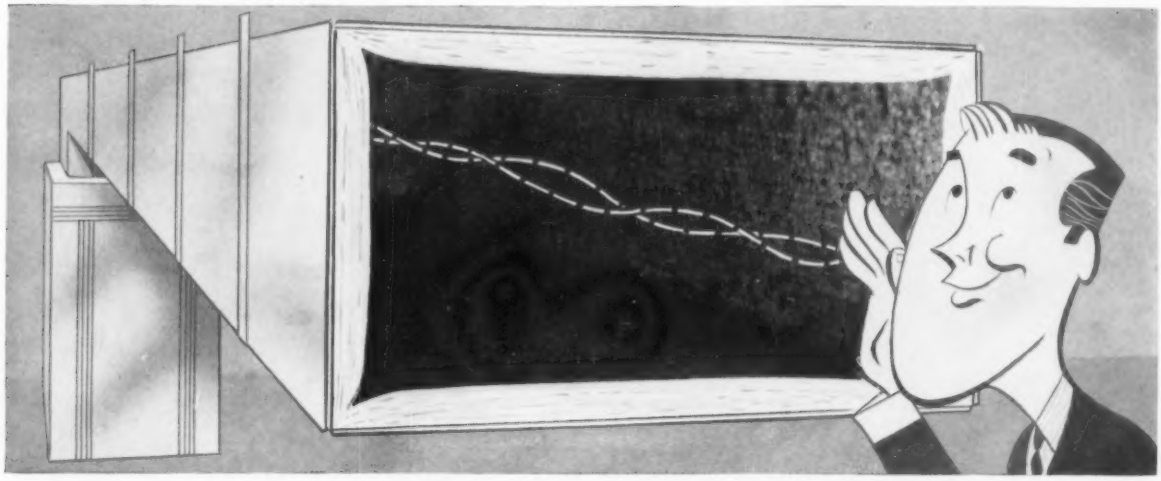
WOLVERINE TUBE
Division of Calumet & Hecla, Inc.
17256 SOUTHFIELD ROAD • ALLEN PARK, MICH.
Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario.

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.
EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK, NEW YORK 6390



Mute air-conditioning-duct noises...



with black-vinyl-coated MICROTEX

New duct liner has high acoustical and thermal efficiency... plus the moneysaving advantages of pigmented vinyl coating

Microtex Duct Liner effectively absorbs mechanical noises—particularly in the 250 to 4,000 cps range, where most air-conditioning and heating-system noises occur. It efficiently insulates warm- and cold-air ducts against heat transfer. When ducts are lined with Microtex, the sheet metal itself acts as a vapor barrier.

L·O·F Glass Fibers' Microtex Duct Liner saves time and money at the job site. Its black vinyl coating saves painting inside ducts, near grilles or large registers; eliminates the possibility of paint flaking off into the air stream. Pigmented vinyl quickly shows inspectors that Microtex Duct Liner is *fully coated* to resist air erosion, even at peak velocities. When ducts are lined, exterior surfaces are easy and economical to paint or finish as desired.

Microtex Duct Liner cuts costs in the shop, too. It's strong and resilient... easily withstands routine shop handling without damage. Microtex is semirigid, yet light in weight... easy to cut, pleasant to handle. Black vinyl clearly indicates the air-stream side as Microtex is applied to the sheet metal. Resiliency of Microtex permits forming insulated metal sheet in the brake without damage.

Get the facts today on economical Microtex Duct Liner in 1½, 2 and 3 lb./cu. ft. densities. Contact your distributor, or write: *L·O·F Glass Fibers Company, Dept. 39-127, 1810 Madison Avenue, Toledo 1, Ohio.*

L·O·F GLASS FIBERS

L·O·F GLASS FIBERS COMPANY · TOLEDO 1, OHIO

B.F.Goodrich

Cell-Tite® does big job at world's biggest hotel

"When asked to equip 3200 rooms of the Chicago Conrad Hilton, the world's largest hotel, with individual air conditioning and heating units, we looked for a tubing that was simple to apply, required a minimum of labor to install, and gave us a perfect vapor seal from 40° F to 220° F at minimum cost," said Albert J. Schauer, design engineer for York Corporation, York, Pennsylvania.

"Cell-Tite solved our problem perfectly. In fact, we are using 35,000 feet.

"B. F. Goodrich Cell-Tite's primary advantage is its versatility. It's pliable, slips over any given configuration, any twists and turns with ease.

"Another major labor-saving technique with Cell-Tite is prefabrication: we prefabricated much of the pipe before installation, cut our labor time by 50%. Time-saving features like this keep us right on schedule. Cell-Tite comes in practical 50-foot lengths, too. This saved about 15% over the cost of other types of insulators that come in shorter lengths.

"Since Cell-Tite is made of thousands of tiny individual air cells, completely sealing the copper tubing from the air, there is no air leakage and no condensation. We regard Cell-Tite as the perfect seal."

Find out how Cell-Tite can cut costs, simplify installation on your next job. Write B. F. Goodrich Sponge Products, a division of The B. F. Goodrich Company, 381 Derby Place, Shelton, Connecticut.

B.F.Goodrich

SPONGE PRODUCTS

The Editors' Pages

HPAC's readers get the "first look" at Chicago's new ventilation code in this issue. It is anticipated that the code will be a forerunner of other cities' codes because of its specific design conditions outlined for industrial and commercial ventilation systems. The code is presented in full on pages 97-110.

See 5 Percent Increase In Dollar Volume in 1958

. . . but construction costs will be higher

GAINS in construction contracts for government-owned facilities and for housing will more than offset slight declines in contracts for industrial and commercial building in 1958, according to estimates of F. W. Dodge Corp.

In its annual outlook for the construction industry, the organization estimates that construction contracts in 1958 will total $33,830,000,000, a gain of 5 percent over the expected 1957 level.

The outlook statement points out, however, that a portion of next year's anticipated increase in dollar volume will be accounted for by higher construction costs rather than additional physical volume.

Contracts for nonresidential buildings in 1958 are estimated at $11,570,000,000, only slightly above the 1957 level. Physical volume, however, as measured by floor area is likely to be down 2 percent in 1958. The spread between the floor area estimate and the expected dollar volume is based on increased costs.

Residential building contracts next year are expected to total $13,760,000,000, up 8 percent from 1957.

Contracts for heavy engineering construction (public works and utilities) in 1958 are likely to total $8,500,000,000, according to the statement. This would represent an increase of 7 percent over the record level of 1957.

The outlook statement says that "The signs and omens for next year seem to point to mild improvement in the construction picture as a whole, with some variations in detail.

"For total building and engineering contracts in the U.S., we estimate $33,830,000,000 for 1958. This would be an increase of 5 percent over this year. Dollar volume of nonresidential building contracts is estimated to increase 1 percent; residential building contracts, to increase 8 percent; total building contracts, 5 percent; and public works and utilities, 7 percent. Public and private ownership projects are expected to share proportionately in such increases.

"Since some further rises in construction costs are anticipated, physical volumes are likely in some cases to increase by somewhat smaller percentages than dollar volumes.

"Increases are estimated for educational buildings, hospitals, religious buildings, and residential buildings. Moderate declines are indicated for commercial, manufacturing and public buildings, social and recreational projects, and miscellaneous nonresidential buildings.

"Conspicuous in any rise in the heavy engineering category would be increased expenditures for new highway construction. Highway construction volume is almost certain to reach a new peak. So also will educational, hospital, and religious buildings if the estimates are realized.

"The total construction contract figure is also estimated to reach a peak next year. Whether the new peaks will seem impressive will depend upon the particular sector of the construction industry from which they are viewed." ⫩

Help Fight TB

Buy Christmas Seals

HPAC Directory Section Coming in January

. . . revised and up to date

THE JANUARY HPAC will contain the 24th annual Directory Section of Heating, Piping, and Air Conditioning Equipment for Industrial, Commercial, Institutional, and Public Buildings.

Thoroughly revised and up to date, the 1958 Directory contains complete product classifications, trade names, manufacturers' addresses, and an additional product classification of all equipment on which information is given in the advertising pages of the same issue. ⫩

See Bright Future For Factory Comfort Cooling

. . . trend is forming

POINTING to an acceleration in orders for industrial air conditioning, Trane Co. has disclosed that the awaited breakthrough for factory employee comfort cooling is in the offing.

While dollar volume is moderate, the company's sales of centrifugal refrigeration for industrial application for the first eight months of 1957 are already 233 percent of year long 1956 sales, says Trane.

According to D.C. Minard, presi-

dent, "We have been watching the industrial field closely and believe that a definite trend toward factory air conditioning is materializing."

To support his contention, Mr. Minard pointed to a recent increase of big industrial orders including 3250 tons of refrigeration for the Martin Co. guided missile plant at Orlando, Fla., and 2500 tons of air conditioning capacity for the new Skokie, Ill., plant of Teletype Corp.

He added, "We believe the same pattern experienced in major office buildings is beginning to take hold in the industrial field. We have found that once 15 percent of desirable office space in a city has been comfort cooled, air conditioning tends to become a competitive necessity. As one improves his facilities through the installation of air conditioning, others accept the challenge. ≠

Construction Cost Index Shows Third Quarter Rise

. . . up 6 points

THE American Appraisal Co. construction cost index (national average) rose 6 points during the third quarter of 1957, as compared to 8 points for the same period in 1956.

This increase is attributed to many new labor contracts with higher wage rates, a general increase in the price of steel, and scattered increases in the prices of other materials.

The index is based upon a detailed analysis of materials and labor required for representative types of industrial building structures, repriced monthly in accordance with (1) prevailing wage scales and labor performance for the various building trades, and (2) quotations for construction materials in 30 key cities in the U. S.

With 1913 as a base of 100, the national average index figure for 30 cities was 217 in 1926, the depression low in 1933 was 150, and the index for September of this year was 670. ≠

Shortage of Graduate Engineers Until 1960

. . . study predicts

A SUBSTANTIAL SHORTAGE of college trained engineers will continue to hamper vital sectors of American industry until 1960, and possibly for several years thereafter unless industry and educational leaders take preventive steps now. This is the conclusion of a survey made by Deutsch & Shea, Inc., manpower consultants.

The demand for engineers during the period 1950-57 was in excess of 46,000 a year, the survey reports, but with the expansion of industrial employment in general and research and development programs in particular, the demand from 1957 to 1960 will be even greater.

During the first period, there were only 33,600 annual additions of college graduates to the engineering profession. That number will increase to 41,500 annually for the coming 3 years, but even that will fall short of the demand.

Although the supply of graduate mechanical and electrical engineers increased 88 percent and 74 percent, respectively, from 1950 to 1957, the supply failed to keep pace with demand. Each branch will have additions of graduate engineers of approximately 20 percent in the next 3 years, but the number will continue to fall short of industry's expanding requirements. ≠

Blame Crowded Trains For Closing Cooled Offices

. . . in New York City

SOME 28 PERCENT of the air conditioned offices in New York do close early in hot, humid weather, according to the Office Executives Association of New York.

But air conditioning is not to blame. The city is primarily a commuting area, and to spare employees the discomfort of crowded transportation on these muggy days many offices close down for morale purposes.

Still, many employees prefer their cool offices to non-air conditioned homes, it has been noted. ≠

HPAC Index for 1957 Available Soon

. . . write for your free copy

FOR YOUR convenience the editorial contents of HPAC, including the Journal Section of the American Society of Heating and Air-Conditioning Engineers, are indexed annually. The 1957 index is now in preparation and will be available early in 1958 to subscribers on request.

To obtain your free copy, write the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill. ≠

Air Conditioning Most Named in Office Survey

. . . contributes to office efficiency

IN A SURVEY of 376 companies, asked to check which of 21 items they consider important to office efficiency, air conditioning was the most often named. Conducted by *Dun's Review and Modern Industry*, the survey showed air conditioning checked by 330 of the companies, or 88 percent.

Of the reporting companies, 290 now have air conditioning and 59 more expect to have it within 3 years. ≠

"Quote"

***"A man of science will likely be the White House occupant within the lifetimes of most of you here."*—Robert W. Galvin, president, Motorola, Inc., at the opening general session of the American Institute of Electrical Engineers' annual fall meeting in Chicago recently.**

Jenni Genetron says,

"HERE'S THE RIGHT REFRIGERANT FOR EVERY NEED!"

genetron® SUPER-DRY REFRIGERANTS

Selected Physical Data
(Performance based on 5°F evaporator temperature and 86°F condenser temperature)

	Trichloromonofluoromethane genetron 11 ORANGE LABEL	Dichlorodifluoromethane genetron 12 WHITE LABEL	Monochlorodifluoromethane genetron 22 GREEN LABEL	Trichlorotrifluoroethane genetron 113 PURPLE LABEL	Dichlorotetrafluoroethane genetron 114A DARK BLUE LABEL
Chemical Formula	CCl_3F	CCl_2F_2	$CHClF_2$	$C_2Cl_3F_3$	$C_2Cl_2F_4$
Molecular Weight	137.4	120.9	86.5	187.4	170.9
Boiling Pt. (°F) at 1 Atm. Pressure	74.7	—21.6	—41.4	117.6	37.6
Evaporator Pressure at 5°F (p.s.i.g.)	24.0*	11.8	28.3	27.9*	15.6*
Condensing Pressure at 86°F (p.s.i.g.)	3.6	93.3	159.8	13.9*	22.7
Freezing Point (°F) at 1 Atm. Pressure	—168	—252	—256	—31	—76
Critical Temperature (°F)	388	234	205	417	294
Critical Pressure (p.s.i. absolute)	635	597	716	495	478
Compressor Discharge Temperature (°F)	112	101	131	86	88
Compression Ratio (86°F/5°F)	6.24	4.08	4.06	8.02	5.33
Specific Volume of Saturated Vapor at 5°F (cu. ft./lb.)	12.27	1.46	1.25	27.04	4.04
Latent Heat of Vaporization at 5°F (B.t.u./lb.)	84.0	68.2	93.6	70.6	60.2
Net Refrig. Effect of Liquid—86°F/5°F (B.t.u./lb.)	67.5	50.0	69.3	53.7	43.0
Specific Heat of Liquid at 86°F (B.t.u./lb.°F)	0.21	0.24	0.34	0.22	0.23
Specific Heat of Vapor at Constant Pressure of 1 Atm. & 86°F (B.t.u./lb.°F)	0.13	0.15	0.15	0.15	0.16
Specific Heat Ratio at 86°F & 1 Atm. (k = Cp/Cv)	1.14	1.14	1.18	1.09	1.01
Coefficient of Performance	5.09	4.70	4.66	4.92	4.60
Horsepower/Ton Refrigeration	0.927	1.002	1.011	0.960	1.025
Refrigerant Circulated/Ton Refrig. (lbs./min.)	2.96	4.00	2.89	3.73	4.65
Liquid Circulated/Ton Refrig. (cu. in./min.)	56.0	85.6	68.0	66.5	88.7
Compressor Displacement/Ton Refrig. (c.f.m.)	36.32	5.83	3.60	100.76	18.78
Toxicity (Underwriters' Laboratories Group No.)	5A	6	5A	4-5	6
Flammability & Explosivity	None	None	None	None	None

*Inches of mercury vacuum.

COMPARE! Careful control at every step in the manufacture of "Genetron" Super-Dry Refrigerants results in products of highest purity, which are extremely low in moisture content and other undesirable impurities. Quality of current production consistently *surpasses* the rigid manufacturing specifications for these products. Write for important informative folder "Genetron Super-Dry Refrigerants."

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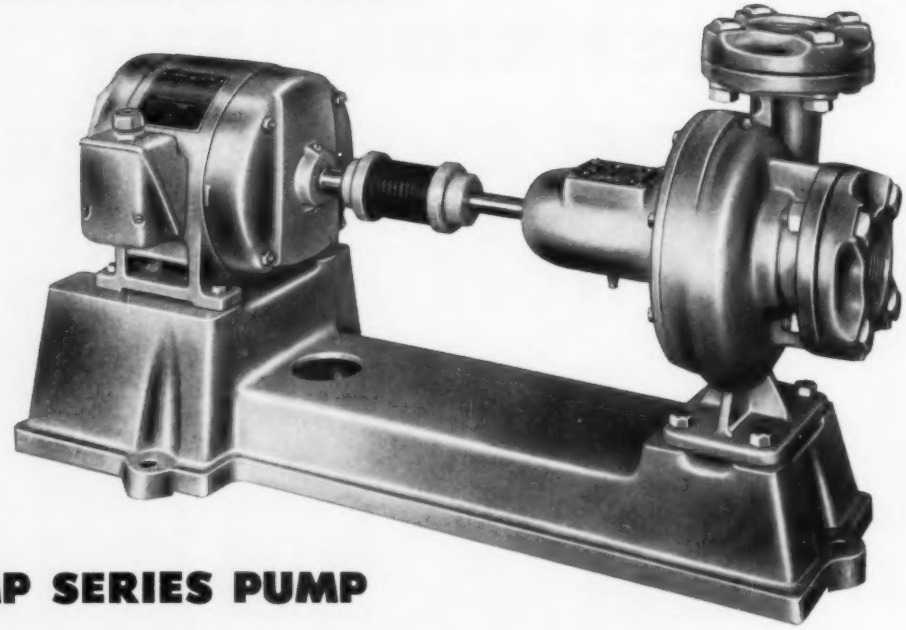
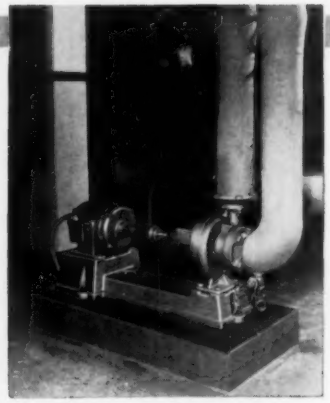


MP SERIES PUMP



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- Water-tight, self-adjusting, self-lubricated mechanical seals.
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- A long-life impeller shaft of stainless steel, hardened and ground to a mirror finish.
- Bronze bearings in bracket, separated by a thrust collar attached to the shaft, absorb all end thrust.
- An oil bath circulating system with modern slinger rings, lifts oil to both bronze bearings.
- Bearing bracket, impeller and shaft are completely removable without disturbing motor, volute or piping connections.
- A closed type impeller of bronze or cast iron, dynamically balanced for smooth noiseless operation and designed to eliminate hydraulic thrust.
- Volute on body legs bolted directly to the base prevent piping strains from changing pump alignment.
- A base of cast iron designed with a three-point floor mounting to simplify leveling. Provision is also made to fill with concrete for sound deadening.

For the features that mean a better performance for every large hot water heating or cooling system, put the new Taco MP series pump on the job!

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"Open for Discussion"

• *WE FOLLOW HERE each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

Check Available Preheater Types; Or Maybe Design Own Equipment

I SPECIALIZE in heat recovery and have read with interest E.J.M.'s question, *How Can Makeup Air Be Heated?*, and the answers given by Sol Schwartz and H. B. Wayne in the October HPAC.

I agree with Mr. Wayne that, in this regenerative circuit, a direct gas-to-air heat exchanger would be the most effective solution.

In selecting the proper heat transfer equipment, E.J.M. might do well to examine both recuperative and regenerative air preheaters which are in standard use in steam-electric generating stations throughout the world. Also, four manufacturers of this type of equipment are listed in the January 1957 HPAC Directory Number under units, heat recovery, air-to-air.

E.J.M. may find it most expedient to design and have his own equipment fabricated. I have had occasion to do just that. Such a heat exchanger with rectangular tubes of 0.016 in. thick aluminum sheet was used to winter air condition a poultry house sheltering 200 laying hens, with signal success.

Frost and ice formed in the exhaust air tubes due to the removal of the latent heat of condensation and fusion was transferred to the supply air when the ambient temperature was −12 F. It was found, that on a given amount of aluminum surface per 100 cfm of supply and exhaust air, that the free temperature gain of the supply stream ranged from 60 percent when the exhaust stream remained dry, to 79 percent when the exhaust stream formed condensation.

Corrosion and fouling are both critical factors here. The latent heat of condensation so greatly enhances the amount of recoverable heat that it may be worthwhile to protect an aluminum or copper surface with gold plating.

PAUL M. STURGES
Industrial Consultant
Stone Ridge, N. Y.

Interest in High Velocity Air Conditioning Stimulates Improvement

THE COMMENTS of N. S. Shataloff, in the June HPAC, and W. L. Batchelor, in the July HPAC, on my article, *How to Balance High Velocity Air Conditioning Systems* in the March and May HPAC's are appreciated. Such interest stimulates the thinking of the engineers to provide better techniques to solve our present problems.

The classification of dual duct high velocity systems into three general groups as outlined by Mr. Shataloff is reasonable. Information on balancing the first group of systems was given in the article. On systems of the second group which supply air from a common coil plenum to more than one zone or exposure, the same instructions would apply, since practical limitations on refrigeration equipment size would require 100 percent cooling air capacity at peak loads. Use of separate coils for each zone or exposure with excess cooling and/or heating capacity available at each terminal is a special case that requires close coordination with the designer. Information on the schedule of temperatures, mixing ratios and probability factors are needed to properly balance this type system.

As Mr. Shataloff points out, the third group of systems, those with a constant volume device at each terminal, do not require balancing in the conventional sense. The availability of high velocity units of the constant volume type permits the adjustment or dialing of the volume damper to the design capacity before the system is operating. The inclusion of this feature assures the engineer of the design flow through the air diffuser regardless of any changes in duct pressure loss, supply air temperature or hot to cold volume ratios. I agree that the use of a constant volume device within each high velocity terminal will give a closer control of unit capacity than central station "static unbalance" controls. The major control companies have now produced standard controls of the compressed air or selfcontained type to accomplish this in standardized attenuator diffuser combinations.

With reference to the comments of W. L. Batchelor, the risk to overgeneralize is high when covering a broad subject, short of a textbook treatise. On large installations with repetitive modules, the use of many units at identical capacities is common. Although the static pressure at each unit is different for the identical capacity, it is possible to determine the probable average or mean static pressure at which the units will operate. With the valves of all units closed partially to this particular condition at the time of final functional inspection in the manufacturer's plant, the total system resistance — duct and terminal loss — will

approximate the design condition much closer than with all unit valves fully opened. Although this may be inferred as a prebalance before installation, this method does not require fitting one box to a specific location, and yet eliminates the trial and error adjustments experienced when starting the balancing with fully opened valves on all high velocity units.

Use of branch line duct dampers as described by Mr. Batchelor can help in the balancing of the system, but are seldom necessary in properly designed systems. Because special high velocity dampers must be installed in accordance with the manufacturer's recommendation and automatic static regulating dampers must be used in dual duct systems as he states, the designer should understand that on dual duct systems, regulation or control is required with a reduced cfm flow condition. Therefore, the size of the damper must be selected with extreme care.

WILLIAM J. WAELDNER
Anemostat Corp. of America
New York, N. Y.

Compares School Heating Costs, Efficiency Based on Btu per Hr

I READ WITH INTEREST the article *Heat Schools Electrically?*, by Robert Lee Boyd in the December 1956 HPAC, but I question the author's basis for computing the costs and efficiency of electric heating.

The statement was once made that if a room was insulated well enough, a normal light bulb would keep it warm. It might be well for us all to ask what is the actual added cost of construction which is unusual to normal methods used for this building, that can hold the costly Btu of electricity?

May it be possible that the design requirements of the conventional systems were so high that they could not be properly evaluated?

Certainly this must be a new idea in the method of heating control to cut heating costs. Could this also be applied to other fuels? The following is a list of Btu comparisons for 2c and 1.6c per kwhr electric rates. Surely the manufacturers of equipment should be asked why cannot the Btu of cheaper fuels be obtained and put into a building with equal efficiency and comfort.

	Cost of other fuels to equal electricity		Approximate actual cost	Efficiency of other fuels to be equal to electric heat, percent
	@2c/kwhr	@1.6c kwhr		
Natural gas, 1000 Btu per cu ft	$5.87	$4.70	$0.65	13.9
Propane, bottle gas, 92,500 Btu per gal	$0.587	$0.433	$0.15	34.8
Light oil, No. 1, 135,000 Btu per gal	$0.70	$0.63	$0.16½	26.1
Heavy oil, No. 6, 150,000 Btu per gal	$0.88	$.705	$0.108	15.3
Coal, smokeless, 30,000,000 Btu per ton	$176	$145	$18.75	1.29
Coal, Indiana, 26,000,000 Btu per ton	$153	$122	$10	0.82

I know of no system with operating efficiencies as low as these. If conventional systems cannot transfer Btu from the fuel to the room at better efficiencies than the above, electric heat should be considered.

Mr. Boyd admits that, Btu for Btu, electric heat is costly and requires special insulation and control to keep the cost within a range that is not objectionable. $2669.60 electric cost equals 166,850 kwhr. or 569,459,050 Btu, and at 60 percent efficiency with No. 1 oil a cost of $1160. Therefore, a $1509.60 saving could be made by using oil. It is my belief that with the present costs any of the conventional fuels can substitute their Btu's—under the same condition of insulation and operation—to a degree that one would not consider electricity for heating.

This does not appear to be a situation that will change since electricity is created from the conventional fuels. Although atomic energy may practically eliminate the cost of fuel, it is estimated by some that electric rates will still not be appreciably lowered to be competitive.

GEORGE L. WIGGLESWORTH
Engineer
Kokomo Gas and Fuel Co.
Kokomo, Ind.

THE AUTHOR'S REPLY—The architect estimates between $40,000 and $60,000 was saved in initial construction costs. This is reported in *Electric Unit Heaters Cut Cost of School*, by T. A. McConnaughey, architect, in the December 1955 HPAC, and in *School Heated by Electricity*, by James A. Melone in the March 1956 Qualified Contractor. On school bonds at 3 percent—low for today—this would justify about $1500 extra cost for fuel based on interest alone, with no reduction on the principal. On the new rate for this school, the energy consumption for last year would have cost about $530 less. In addition, the school board counted on savings in attendance and maintenance labor, and it is believed they have not been disappointed.

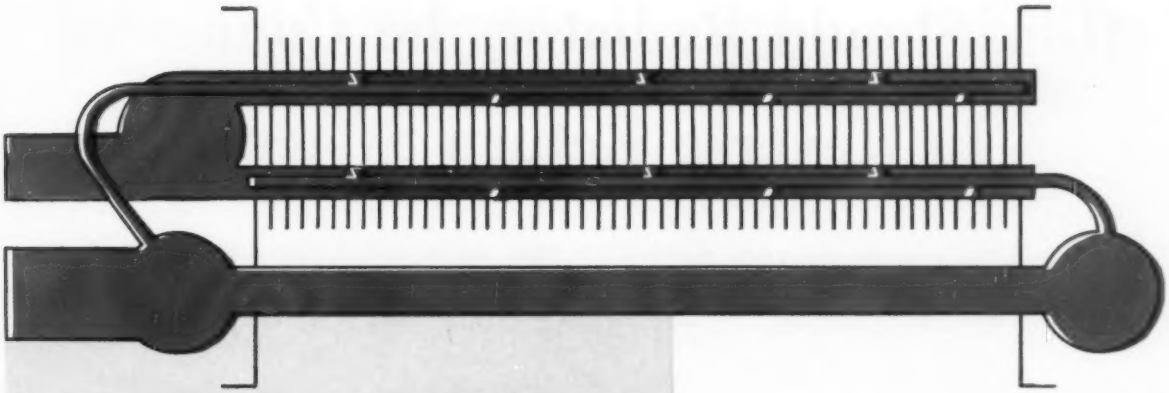
There has been no attempt to disparage or analyze other means of heating, as there are many who are better qualified for such analysis than I am.

The tabulation of costs and efficiencies required for various fuels is interesting and leads to the conclusion that some reason other than cost of a Btu must dictate against the universal use of Indiana coal for all fuel purposes. While there may be a question of the comparative evaluation of $2669.60 worth of electricity to No. 1 fuel oil which Mr. Wigglesworth indicated in his comments, $1509.60 savings made with oils can be substantially offset by the $1500 interest on the additional investment for the complete conventional school. The $530 saving due to electric rate reduction compares to recent increases in cost for fuel oil to further justify the judgment of the Hartford City, Indiana, school board who showed the electric heating industry how practical it is to heat schools electrically today.

ROBERT LEE BOYD
Development Engineer
Electromode Div.
Commercial Controls Corp.

A COMPLETELY NEW STEAM COIL DESIGN

Marlo EVNTTEMP Distributing Steam Coil



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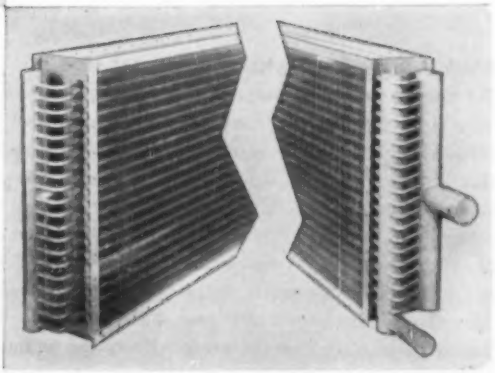
Regardless of Fluctuating Load Demands

This unique new steam coil provides uniform leaving air temperatures, free of all stratification. The design also gives maximum possible protection against freeze-ups not available before.

Fins of the new Evntemp coil are of the continuous-plate type which contact the entire surface of the condensing tubes, assuring efficient, uniform heat transfer. Tubes are pitched in the casing for rapid condensate drainage and ease of installation.



Complete information on the new Evntemp steam coil is available on request. Write today.

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Question of the Month

How Should Radiators be Connected In Reverse Return System?

This question was asked previously in HPAC and is repeated here, along with answers that have been received from readers. Other answers or comments for publication are invited.

"We have installed a two pipe reverse return hot water heating system which is giving us trouble.

"The mains are 12 ft overhead which supply the radiators at the top. The water is returned through risers connecting the bottoms of the radiators and the return line. The bottoms of the radiators are cold even though this is a forced circulation system.

"How should the radiators be connected to prevent the short-circuiting?"—C.J.H.

Make Supply, Return Connections At Bottoms to Insure Operation

THE RADIATORS should have both the supply and return connections made at the bottom. The reason for this is that the cross-sectional areas of the water passages inside the radiator are relatively large, so the velocity of the water through the radiator drops almost to zero, and convection takes over and holds the hot water predominantly at the top of the radiator. Several columns would, of course, be warm due to the forced circulation, but the remainder of the radiator, excluding the top, would probably be cold. The fact that the bottoms of the radiators are cold bears this out.

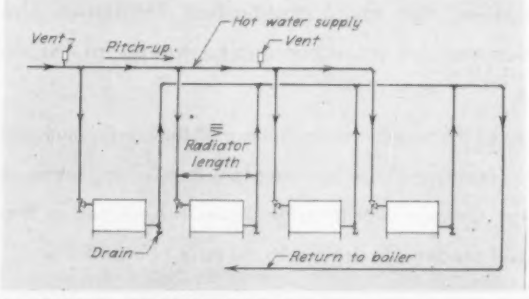
With both connections made at the bottom, the forced circulation insures hot water across the bottom of the radiator, and convection currents within the radiator will keep the remainder hot.

A further contributing cause could be an undersized circulating pump, or the circulating pump running backwards.

I. D. PATTERSON
Consulting Engineer
London, Ontario, Canada

Pitch Headers in Direction of Flow; Install Vents to Relieve Air, Gases

TO ALLOW proper water flow and heat distribution, the supply headers should be pitched in the direction of flow. Also, vents should be installed in the mains to relieve the circuit of air and other noncondensible gases that comes out of solution during heating periods. Frequently, these two adjustments make the difference between satisfactory and faulty operation.



1 PIPING ARRANGEMENT for two pipe reverse return hot water heating system has supply header pitched up in direction of flow, air vents installed in header

Fig. 1 shows what I believe to be a proper arrangement of piping for a two pipe reverse return hot water heating system.

H. B. WAYNE
Consulting Engineer
Woodhaven, N.Y.

(Continued on page 74)

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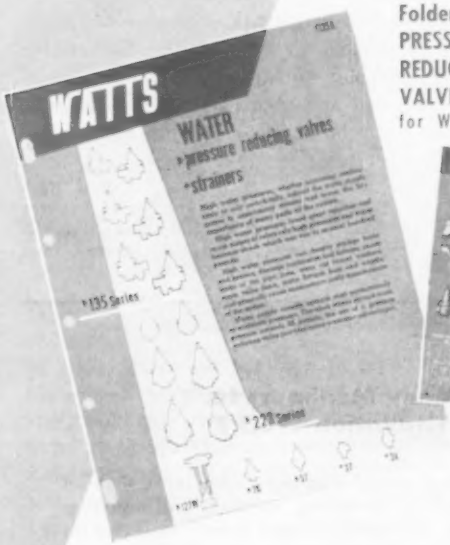
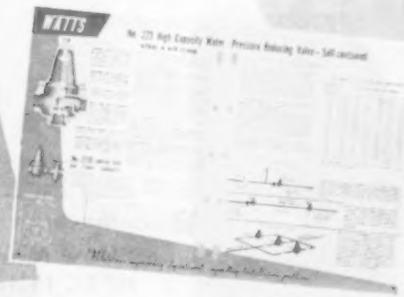




WATTS

REGULATOR COMPANY

How Should We Heat a Thawing Shed?

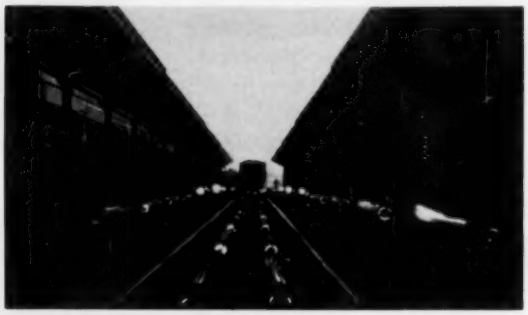
Answers to this question appeared in July and August. Here's still another solution.

"We have been asked to design the heating system for a coal and ore thawing shed where the temperature is to be maintained at 200 F. It seems that direct fired heaters would satisfy this requirement, and this has been suggested. If direct fired heaters are to be used, the air within the shed is to be recirculated through the heater continuously. Ducts will be used to distribute this heated air to the locations in the shed where it will do the most good in the thawing operation. The ice crust around the perimeter of the coal and ore cars is about 15 in. thick under design conditions."—R.C.B.

Oil Fired "Hot Dogs" Provide Large Radiating Area at Small Fuel Input

AN EXAMPLE of an oil fired coal car thawing installation which has been successful in handling as many as 14 cars per hour for the past two winters is located at a large midwestern plant. It consists of perforated alloy radiant tubes laid between the tracks and just outside the sides of the coal cars. Each tube is fired with a small light oil burner using 20 oz per sq in. air to atomize the oil. This unique system employs both radiation and convection in a sturdily constructed unit that is not harmed by water and dirt falling on it.

The 6 in. diameter, 6 ft radiant tubes provide a large effective radiating area for a relatively small fuel input. The hot exhaust gases emitting from the holes in the top and end of each tube rise to flow over the hopper surfaces and sides of the car, thus further utilizing the heat from the fuel by convection.



"HOT DOGS" are laid between tracks and just outside sides of coal cars

The tubes are made of ⅛ in. special alloy which withstands the thermal stresses resulting from exposure to flame on the inside and dripping water on the outside surface. This tubing is highly resistant to oxidation, so corrosion is no problem.

Each tube is cradled in a V-shaped support that permits the end opposite the burner to "grow" away from the burner as the tube expands. The cast iron tube-holding ring on the burner is designed to hold the burner end of the tube fixed while still permitting easy disassembly of the tube from the burner. The perforations in the top and the orifice across the end of the tube are sized and located so as to achieve a high rate of radiation heat transfer before the gases are released for convection heating.

Some of the radiant tube units, which are called "hot dogs" by the operators who are spared the dirty and dangerous job of climbing over and under cars with torches and steam lances, are nestled between the the rails and are located so that their top surface is flush with the top of the rails. Those outside the rails (5½ ft from center line) are elevated about 10 in., which adequately protects the journal boxes from the hot exhaust gases. Metal plates protect the ties from localized overheating.

A 254 ft long wind break is on each side of the tracks. This was less expensive than a complete enclosing shed, which is not needed since the heat is released immediately adjacent to car hoppers and sides.

The burners are lighted by one man while another opens the manual butterfly air valves and oil valves as the torch is applied to each burner. Observation windows in the wind break allow the two men to coordinate their operations.

R. J. REED
Application Engineer
North American Mfg. Co.
Cleveland, Ohio

READER ASKS —

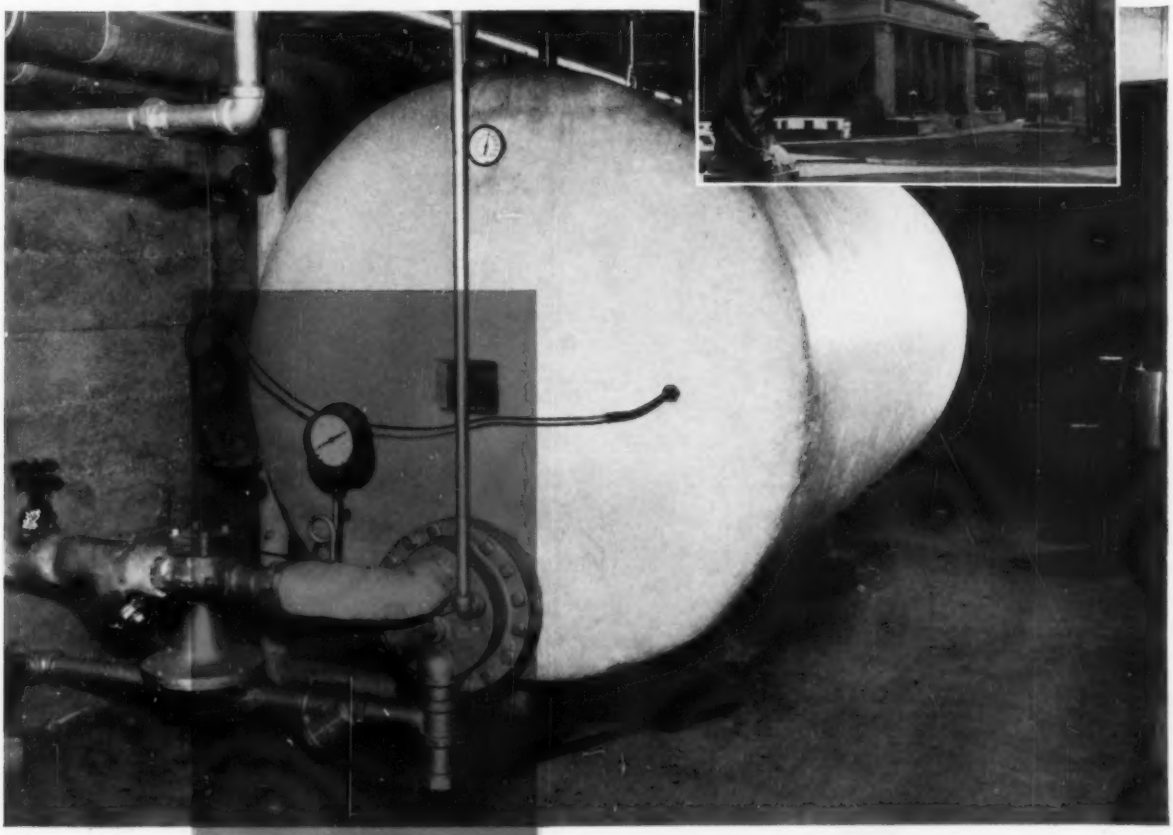
"How Many Manhours for HPAC Installation Work?"

"How many manhours may be estimated for cutting, threading, welding, and installing piping of various sizes? I am interested in obtaining this information for modification of heating, piping, and air conditioning systems in an industrial plant.

"Also, I would like to have manhour values that have been established for insulating piping and assembling and erecting ductwork."
—W.W.G.

• *YOU ARE INVITED to contribute a question for publication or an answer to a published question. Write: The Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

This p-k copper-lined storage water heater furnishes an abundant supply of rust-free hot water in the field house at Marywood College, Scranton, Pa.

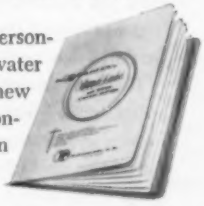


Marywood College depends for rust-free hot water on p-k copper-lined storage heaters

In 1949, Marywood purchased a p-k copper-lined heater shell to replace a plain steel heater in O'Reilly Hall. Failures of the old plain steel tank had made immediate replacement necessary. The success of this installation caused the college to specify p-k equipment for a new music hall, residence building, science building and field house, all part of a continuous expansion program.

You can expect such results from p-k copper-lined heaters. By combining the noncorrosive qualities of copper with the superior strength of steel, you are assured of an uninterrupted supply of rust-free hot water . . . year after year. And Patterson-Kelley copper-lined heaters are opened for inspection every two years, and require no maintenance except the removal of sediment.

To get all the facts about Patterson-Kelley copper-lined storage hot water heaters, write for your copy of the new data file No. 16 today. The Patterson-Kelley Co., Inc., 2112 Warren Street, E. Stroudsburg, Pa.



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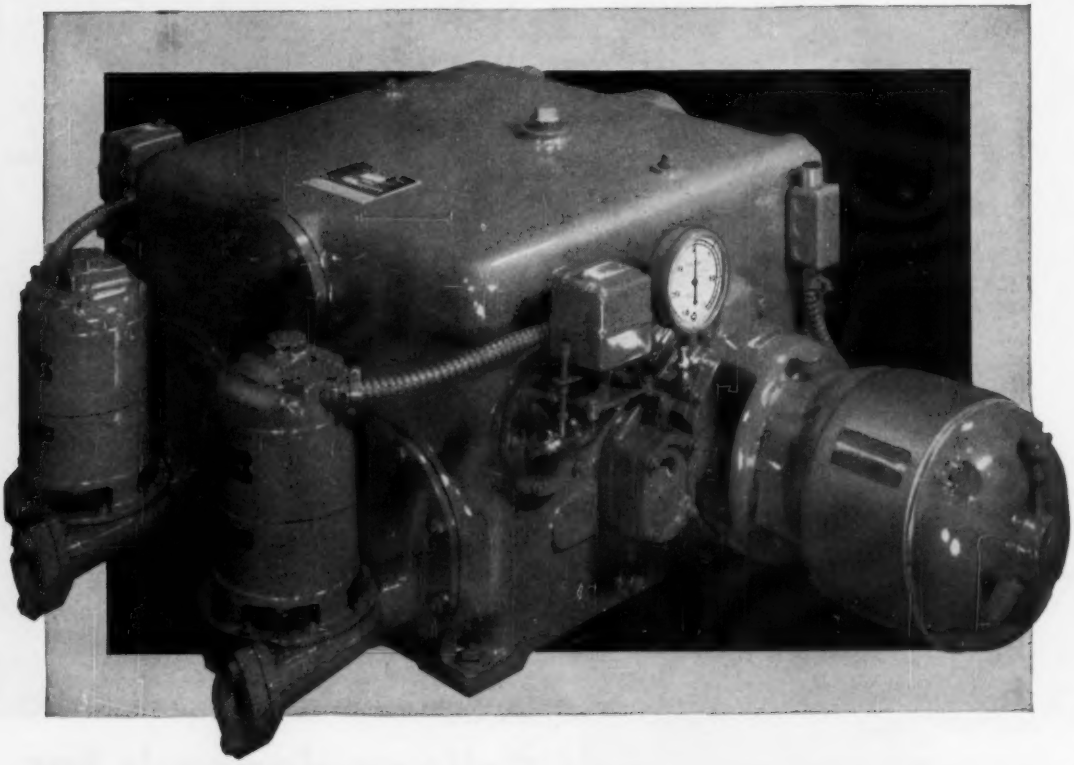
HAS THE INCREASED AIR CAPACITY EFFICIENT HEATING PRACTICE DEMANDS



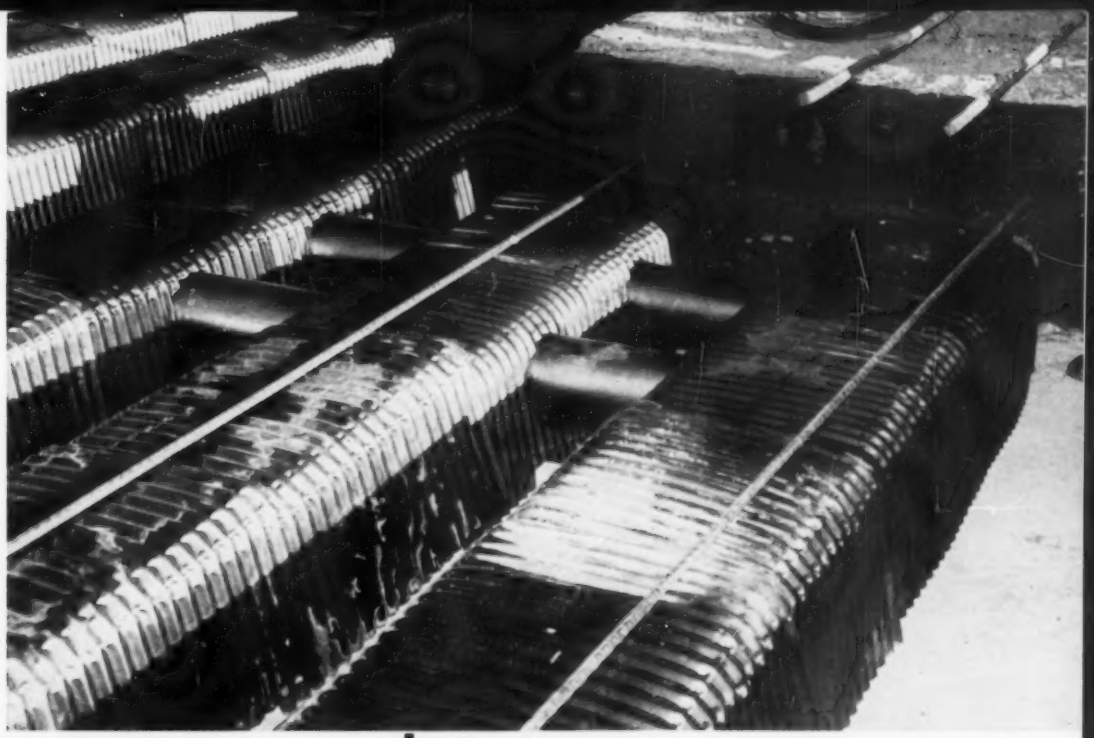
It's the Nash CSM

Designed and manufactured by the organization that made the Jennings Manifold Heating Pump standard of the Heating Industry, the new CSM incorporates every desirable feature architects, engineers, owners and operators have sought. Employing separate air and water pump elements, each with its own motor and each independently controlled by its own automatic switch, the capacities and arrangement may be widely varied to meet job conditions. For the first time, the engineer has the choice of realistic water and air capacities required for rapid system response without wasteful overheating.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY
437 WILSON, SO. NORWALK, CONN.



PERMAFROST TABLE must not thaw, so engineers developed subflooring construction of metal pan and rough slab, shown, to convey cold air

Army Vies with Nature To Heat Arctic Air Base

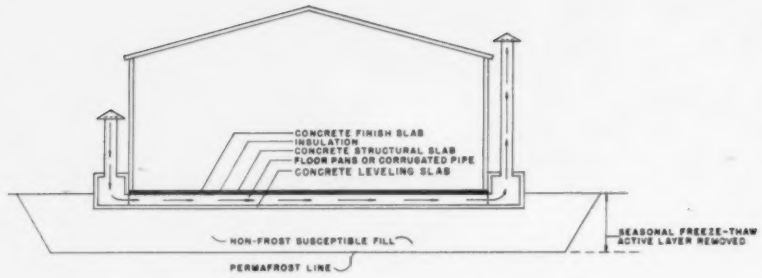
The need for strategic air bases, the Arctic's short construction season, keeping the site's permafrost table from thawing, and maintaining a 70 F year 'round indoor temperature while the outdoor design temperature is —40 F were factors that made this one of the biggest heating feats in construction history—at "the farthest place." And the Greeks had a word for it: "Thule."

BY NELSON E. PEARSALL* and WALLACE O. McCLUNE*

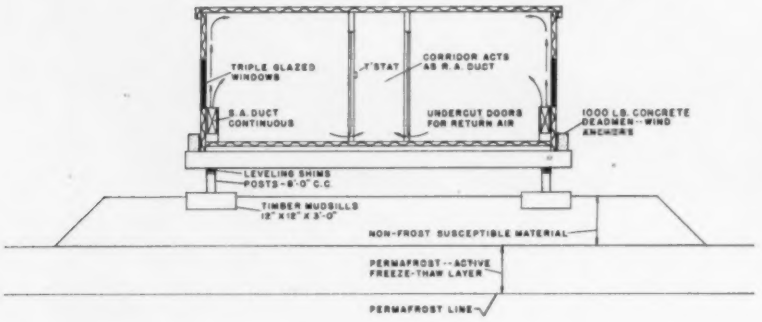
THE TASK of building "Project Blue Jay" — the multimillion dollar Thule Air Base on the northwest coast of Greenland — confronted the Army's Corps of Engineers with seemingly insurmountable problems.

Recorded knowledge of climatic conditions in the area was sketchy. Engineers with arctic experience were practically nonexistent. The

*Chief Mechanical Engineer and Chief Architect, respectively, Design Branch of Engineering, Eastern Ocean District, U.S. Army Corps of Engineers.



FOUNDATION CONSTRUCTION for buildings required to support heavy floor loads is illustrated here. Consists of slab-on-ground ventilated type floor



LIGHTER OCCUPANCY BUILDINGS are built 3 ft above ground level. Crawl space is open, so that circulated cold air disperses heat emitted from structures

shipping and construction season was exceptionally short — about 90 days. On top of this, the time schedule called for the building of an operational air base in only eight short months.

In February 1951, when the Army Engineers first inspected this remote site, they discovered the paramount problem to be overcome: that of providing adequate heating facilities for the huge air base. At Thule the Greenlanders for a thousand and more years had heated their igloos with soapstone lamps filled with seal oil. The heating system for the air base had to be as different from soapstone lamps as modern air base facilities are from Greenlander igloos in order to enable the personnel to live and work in comfort.

Because of strategic military necessity, there was no time for extensive research, lengthy conferences, nor detailed experiments to develop an entirely new heating method suited to arctic conditions. The solution lay in a heating system designed around standard heating products which could be procured on a large scale and which, even though untried in arctic use, would furnish adequate heat 24 hr a day every day of the year.

The system to be developed would have to provide a 70 F inside temperature where the yearly outdoor temperature averages zero F and where the normal winter low is −40 F and the normal summer high 40 F. Therefore, the heating system would have to operate against below-freezing temperatures most of the year.

Discover Permafrost Table

Soil testing and foundation explorations revealed that the heating design problems actually began below ground surface. The entire base site is a vast permafrost table that remains frozen, except for an active layer of 2 to 5 ft at the surface. This active layer is subject to seasonal freezing and thawing.

If any building, even with insulated floors, were constructed on a slab-on-ground foundation or over an enclosed crawl space, heat loss through the floors would melt the active layer and cause the building to settle into the permafrost.

Devise 2 Types of Foundation

To combat this, the design engineers came up with two basic types of foundation construction:

For buildings which would be required to support heavy floor loads — hangars, shops, garages, and heavy equipment warehouses — a slab-on-ground ventilated type floor construction was developed. The method of construction is as follows: (1) The active layer of material is removed down to the solid permafrost; (2) the area is refilled and compacted back up to ground level with a nonfrost susceptible material; (3) a reinforced concrete mud slab is poured directly on the compacted fill; (4) a metal pan and rough slab is constructed on top of this as a subfloor (in some cases, 16 in. diameter corrugated metal pipe is used in lieu of the metal pans); (5) 4 in. of in-

sulation is placed on top of the slab; and (6) this is topped with concrete.

Ends of the pans or corrugated pipe extend into plenum chambers on opposite sides of the building. From the plenum chambers, corrugated pipe stacks extend vertically. To take advantage of prevailing wind, stacks on one side of the building are shorter than stacks on the opposite side, so that a continuous flow of air will pass through the floor system and carry away any heat emitted through the floor above.

The second method of foundation construction, reserved for lighter occupancy buildings — barracks, offices, mess halls, and general warehouses — is as follows: (1) A sufficient portion of the active permafrost is removed to level the building area; (2) a gravel pad of nonfrost susceptible material is filled and compacted to an elevation of 3 ft above normal ground level; and (3) mud sills, posts, sill beams and floor systems are constructed to an elevation of 3 ft above the insulating nonfrost pad.

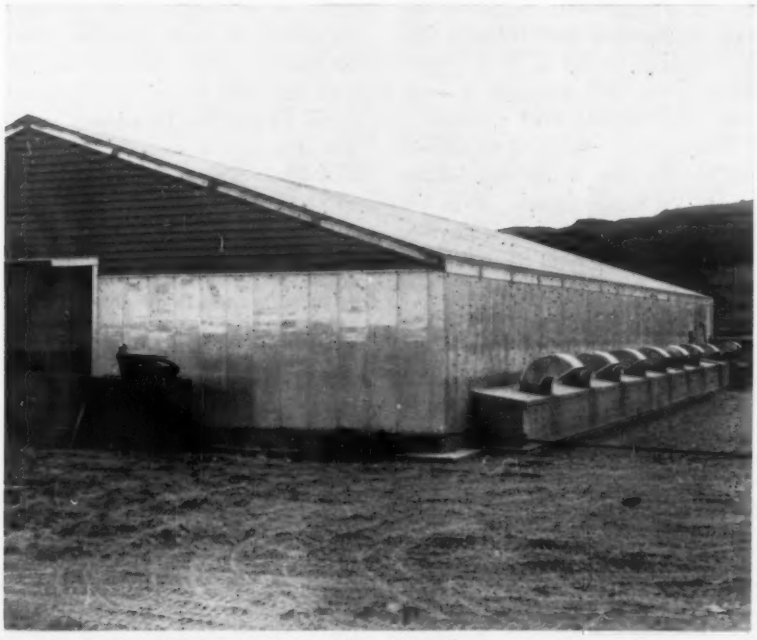
Clear air space beneath the building is 2 ft, 5 in. This construction allows free circulation of cold air beneath the building at all times so that heat transmitted through the floor of the building is dispersed.

The crawl space of these buildings cannot be enclosed. Enclosure would tend to contain the heat loss through the floor; the heat would thus penetrate into the gravel pad, and this in turn would eventually raise the permafrost melting line into the pad, causing softening and settlement.

Both these types of floor construction have been completely successful. To date, no serious settlement has taken place in any buildings.

Use Prefabricated Panels

The design of the buildings themselves was a major factor in determining the required output of the heating system. It was mandatory, due to the short construction season, that a simple, high speed erection system be developed. To meet this need, the design engineers adopted a panelized building system. It consisted of field fabricated framing (timber or steel), to which prefabricated panels were applied for roofs, walls, and floors.



PLENUM CHAMBERS on opposite sides of buildings connect to metal pans in subflooring. Construction permits prevailing wind to provide continuous flow of cold air through floor system to carry away heat emitted through floors above

Panel design consisted of an inner and outer cladding of aluminum sheet bonded to plywood backing over a wooden frame, with the entire cavity filled with glass fiber insulation. The aluminum cladding serves as a moisture barrier. Panel thickness is 4 in., allowing 3½ in. of insulation. In cold storage warehouses these panels are increased to 6 in. At Thule, even cold storage warehouses must be heated occasionally.

How Heating System Works

To illustrate the heating design, a barracks building will serve as an example. The typical barracks averages 26 ft, 8 in. × 176 ft, 2 in. The roof is flat, with an 8 ft eave height. The enclosed heated space is 38,000 cu ft. Rooms are spaced at 8 ft intervals on both sides of a full length corridor. Mechanical and toilet rooms are all at one end of the building.

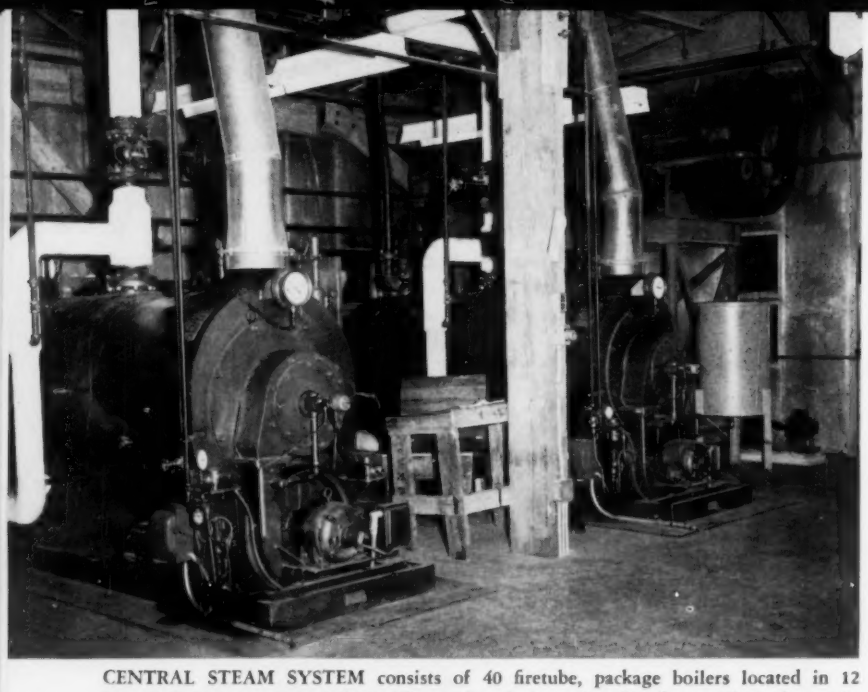
Heating design wind load is 30 mph. The *U* factor is 0.10 for roof, floor, and walls; 0.28 for triple glazed, fixed windows; and 0.52 for doors.

Heat is furnished through a steam coil supplied by a central steam plant. Heat distribution within the structure is by means of a central fan warm air system which also supplies the necessary ventilation air at approximately 15 percent of the total heated air requirement. This is equal to 10 cfm per man, based on 32 man occupancy. Outdoor air is balanced by an equal exhaust for toilets and mechanical spaces.

The central fan system distributes through parallel ducts at each side of the long building, with adjustable outlets at the top of the duct for vertical distribution into each bedroom. The required air volume is based on a delivered air temperature rise of about 36 F, with each space at 70 F. Cooled air is returned through door undercuts to the center corridor for return to the fan system.

An auxiliary warm air furnace of conventional design is connected to the same duct system. Thermostatic control of both of the above systems is located in the return air stream and regulated at 70 F.

The total heat load is equal to



CENTRAL STEAM SYSTEM consists of 40 firetube, package boilers located in 12 plants. System generates 445,000 lb per hr of steam for distribution through 8 mile network. Boilers average 300 hp each

121,500 Btu per hr, which, added to a hot water load of 110 gph, results in a steam draw from the central plant of not less than 281 lb per hr.

Outdoor air is preheated in two steps from −40 to zero F and zero to 36 F. A mixture of outdoor air and return air is then reheated to delivered air temperature of 106 F. The coil is designed for delivering air at a maximum temperature of 125 F.

A thermostatically controlled 15,000 Btu per hr unit heater is used in the mechanical space, though normal radiation losses will usually provide sufficient heat for this area.

Total circulated air is 3360 cfm, which includes 480 cfm of outdoor air, delivered by a centrifugal fan to the two duct branches. The toilet exhaust is designed to remove the 480 cfm from toilets and showers to provide a balance. Static pressure duct losses are based on approximately 0.1 in. water gage per 100 ft of duct for friction.

Equipment, in addition to heating coils and an auxiliary or standby furnace, consists of a duplex condensate return pump at 2000 EDR capacity with 10 gpm pumps at 50 psig discharge, and a pressure reducing station (¾ in., 100 to 5 psig, 461 lb per hr capacity).

The auxiliary furnace is fired with Class 3 arctic pour diesel oil and is completely automatic in operation. A 275 gal storage tank is supplied through a connection outside of the building. Furnace capacity is 330,000 Btu per hr at the bonnet, with a blower capacity of 3360 cfm at 0.5 in. WG static pressure external of the unit. An induced draft fan with 300 cfm capacity at 0.5 in. WG is provided in the stack discharge to overcome high outside wind pressure.

Temperature control, of the adjustable electric type, is provided for the central fan system. Steam valves are controlled in series with duct thermostats, including a high limit thermostat at the fan discharge to prevent overheating. A pressure regulator is provided to shut down the fan in the event of failure of the reducing station or steam supply. Automatic dampers are provided at outdoor air intakes. Both the warm air furnace and final reheater in the fan system are controlled by room thermostats in the corridor to provide average space conditions.

This type of heating has been satisfactory in all buildings except hangars, warehouses, shops, and other structures with heavy floor loads. In these buildings the perimeter duct system is not practical. Unit heaters had to be used to prevent blocking off and stratification of heated air, especially in the buildings with pitched roofs.

In the design of living and working areas in arctic regions, humidity is an important consideration. Humidity in the Thule area is extremely low during the winter months. After the heating system was installed, relative humidity in the buildings was below 25 percent. To prevent excessive dehydration and skin dryness, humidifiers had to be added to the system. The immersion or spray type was installed.

Supply Large Steam Demand

The central steam system at Thule consists of 40 boilers strategically located in 12 plants. The system generates a maximum of 445,000 lb per hr of steam for distribution through an 8 mile network.

Boilers average 300 hp each, operating at 100 psig with water treatment provided. They are firetube package type, completely automatic, and are equipped with burners, forced draft fans, electronic flame failure protection, and feed water control.

INSULATED STEAM LINES, condensate return lines are enclosed in corrugated metal conduit. Conduit is cradled on wooden blocks, laid directly on ground

Fuel is Class 3 arctic pour diesel, suitable for both boiler or diesel use without preheating. This oil is free flowing in temperatures as low as −80 F and produces approximately 143,000 Btu per gal.

Fuel storage tanks are inside the boiler plants to keep the oil at room temperature. To insure against sticking of moving parts of pumps and fans, manufacturers of the installed boilers were required to specify particular lubricants which tests had proven suitable for operation under arctic conditions.

Distribute Steam Above Ground

Steam distribution is through an insulated above ground system. An underground system was considered, but was discarded because of possible damage resulting from heave and settlement caused by freezing and thawing in the active layer of the permafrost table. The easier maintenance of an above ground system was also a consideration.

The system consists of an insulated corrugated conduit enclosing both steam supply and condensate return lines. The conduit was procured in prefabricated sections with internal supports to carry the pipe weight and insure pipe alignment. External support for the conduit housing consists of wooden cradles laid directly on the ground or *X* and *A* frames where the conduit must be elevated above ground. All pipe connections within the conduit are welded to prevent leakage of screwed or bolted joints.

Both steam and condensate lines are encased in 2 in. insulation within the conduit. In some branch lines the insulation is placed around the inner surface of the conduit housing instead of around the steam and condensate lines. This is done to utilize heat from the steam line to prevent freezing of the condensate line.

In other areas, where the heating load is so light that there is greater danger of freezing of the condensate line, bypasses have been installed between the steam and condensate lines. Bypasses consist of ½ in. lines with valves.

When outdoor temperature causes temperature in the condensate line to lower to the danger point, the hand valve is cracked to admit live steam to the condensate line to prevent freezing.

Piping sizes range from 10 in. mains to 2 in. lines into individual buildings. Condensate return lines range from 2 in. down to 1 in., depending on requirements.

Expansion in main lines is controlled with expansion loops at calculated intervals. All low points in steam lines are provided with traps to collect condensate and discharge it into the condensate return line. Condensate within the buildings is collected in duplex condensate units and pumped periodically into the return lines.

Maintenance Crucial Factor

Just as weather was of prime consideration in the design and construction of the heating systems, it is also a primary factor in maintenance. During winter no system or line can be shut down safely for more than 1 hr without draining all low points. Even in summer, temperature changes are so rapid and unpredictable that no line can be shut down for more than 24 hr without complete draining.

Since loss of heat could easily cripple base activities, a maintenance crew constantly patrols the system to find and repair leaks as soon as possible after they occur. To prevent unbalancing of the individual systems within the buildings, each thermostat is locked to prevent tampering by unauthorized personnel.

More than five years have passed since the initial installation of the first steam plants at Thule Air Base. During this time the operating efficiency of the system has amply justified the choice of design, the method of construction, and the maintenance procedures followed. The system has operated without breakdown. The personnel who man this defense outpost live and work in buildings as physically comfortable as those at any stateside military installation.

Architect-engineering services were provided by Metcalf & Eddy and Alfred Hopkins Associates. Design and installation of the facilities were supervised by the U.S. Army Corps of Engineers' Eastern Ocean District. The heating system was designed by Guy B. Panero, Engineers. ≠

U. S. Industries Hurt by Imports; Need Immediate Help

Wage-Cost Equalization Tax Urged To Protect Brass Mills from Imports Of Pipe, Tube, Sheet, Other Products

IMMEDIATE RELIEF for essential industries now being severely hurt by imports has been urged by T. E. Veltfort, managing director of the Copper & Brass Research Association. Such relief measures, he said, should be granted on a basis which could apply to our foreign trade approximately the same principles of fair competition which govern our domestic business.

Speaking on behalf of the brass mill industry in particular, Mr. Veltfort suggested that such measures should be over and above the present means for redress now available under the trade agreements extension act, such as the "escape clause" and appeal to the Office of Defense Mobilization.

Mr. Veltfort said he recognizes the desirability of strengthening the economy of friendly foreign powers while improving our own industry and agriculture by encouraging freer international trade, as specified in section 350 of the tariff act of 1930. Moreover, he emphasized that neither brass mill manufacturers nor those in other essential American industries would fear competition with foreign producers if their wage levels were comparable with our own.

He cited figures to show that these levels are far apart, however, and that the brass mill industry, which employs about 30,000 persons, has been additionally hampered by loss of certain markets during periods of copper control restrictions imposed in World War II and later during the Korean episode. At the same time, he said, the brass mill industry has ample capacity to meet all foreseeable domestic demands.

The immediate relief sought, Mr. Veltfort explained, would be on an interim quota basis, pending more exhaustive investigation and hearings at which all parties could be heard. Should the situation then prove to be as alleged, one of three permanent procedures for relief could be made available. The three would include:

1) A wage-cost equalization import tax.
2) Increased tariffs.
3) Quotas.

Urges Wage-Cost Equalization Tax

His comments stemmed from a worsening import situation which currently is bringing 100 million lb of brass mill products into the U. S. this year. What this means in terms of job or time loss to American brass mill workers can be realized by considering the 3 million manhours it would take to produce that 100 million lb quantity here. This manhour total is equivalent to a working schedule of fifty 40 hour weeks for 1500 men.

The wage-cost equalization tax contemplated would be designed to equalize the disparity in real wages between workers in exporting countries and United States brass mill workers. As prescribed by Mr. Veltfort, the tax would involve the working out of formulas in connection with specific products which would reflect the relative real wages and the proportion which wages and wage-related indirect costs are of the total cost.

Such a tax would have several desirable effects, said Mr. Veltfort. First of all, it would go a long way toward eliminating the insuperable handicap which the domestic manufacturer has in trying to match his American labor rates with the low wages abroad. By decreasing the tax as wages abroad were raised, the tax also should be an incentive for an increase in foreign wages, he added.

Secondly, the tax proceeds resulting from this procedure could be utilized to reduce the burden on domestic industry. This, Mr. Veltfort pointed out, would obviate in part the anomaly of having our domestic producers taxed to support foreign aid which in turn is used to provide facilities abroad for increasing the quantity of competitive products which come to this country, thus reducing their earnings from which to pay taxes.

He noted further that the tariff act of 1930, section 336, provides a procedure under which the rate of duty can be raised or lowered up to 50 percent of that provided by statute. This is to equalize the differences in the costs of production of the domestic article and the like or similar article when produced in the principal competing country. Unfortunately, he continued, Congress made this remedy inapplicable to items which are the subject of a trade agreement concession. This was done in the belief that adequate remedies otherwise existed under the trade agreements act. This faith obviously has not been justified in the experience of certain important industries, he asserted.

Substantial Tariff Boosts Needed

In reviewing his two other remedial recommendations —increased tariffs and quotas—Mr. Veltfort pointed out that any tariff increase would have to be substantial. In this connection it is interesting to note from the following table how materially average tariffs on brass mill products have been reduced in cents per pound through the foreign trade agreements and, because of inflation, how they have been even more drastically reduced on the basis of percent of value:

Period	Average Duty, Cents per Lb	Average Duty, Percent of Value
1930 - 1938	9.8	41
1950 - 1956	2.0	5

It is obvious from the above that tariffs would have to be raised considerably to provide an effective remedy for the disparity in labor costs between this country and the principal exporting countries.

As for quotas, he said they generally are not desirable as a permanent device because in certain cases they may present the problem of possible discrimination among individual exporters and also among individual importers. For this reason, he explained, it may be very difficult to set them at a fair level.

Imports Have Increased Greatly

Mr. Veltfort cited some revealing figures to demonstrate graphically not only the inroads that imports of certain products have made in the domestic brass mill industry, but also the tremendous disparities in wage

Political Leaders Agree: "U. S. Industry Must Be Protected"

The serious situation which faces certain industries was noted by Sherman Adams, assistant to the President, when at the annual meeting of the American Textile Association, at Portsmouth, N. H., September 26, 1956, he stated:

"The President has made it clear again and again that our foreign trade policy must not wreck our own enterprises nor destroy the jobs of the American workers. We do not intend that it shall.

"The truth is that we can deal with our difficulty successfully without altering fundamentally our foreign trade policy."

Moreover, we have evidence that both political parties consider the situation of concern. In their respective 1956 platforms they stated:

Republican: "Barriers which impede international trade and the flow of capital should be reduced on a gradual, selective and reciprocal basis, with full recognition of the necessity to safeguard domestic enterprises, agriculture and labor against unfair import competition. We proudly point out that the Republican Party was primarily responsible for initiating the escape clause and peril point provisions of law to make effective the necessary safeguards for American agriculture, labor, and business. We pledge faithful and expeditious administration of these provisions."

Democratic: "We pledge correction of these conditions." [Referring to alleged Republican 'flagrant disregard' of the economic welfare of important segments of the American economy in the operation of the reciprocal trade program.]

Wartime Brass Mill Expansion Part of the Problem's Cause

The brass mill industry is of great importance to the national security in times of war and other emergencies because its products are essential in many military and related uses. Before World War II the peacetime peak of brass mill shipments had been about 1.5 billion pounds. Requirements for the war and related essential uses reached an annual peak of 5.6 billion pounds. Of this, the brass mills—through the expansion of their own facilities and their intensive use—produced 3.6 billion pounds, the balance being obtained from government owned, but mill operated, plants and a few auxiliary sources.

By active promotion, research, and aggressive sales activities the industry raised its post-war level of shipments from the average pre-war of about 1 billion pounds annually to over 2 billion pounds. In this effort, the industry neither sought nor was given any government help. It should be noted also, that this growth provided a market for hundreds of thousands of tons of copper imported from abroad.

It is quite impracticable for domestic brass mills to export their products to most foreign countries. Not only are foreign prices substantially lower than prices in the United States because of low wage rates, but tariffs and other restrictions governing the import of brass mill products abroad are more stringent than ours.

The advantage which most of the exporting countries have in low labor rates is not offset by any lack of know-how, up-to-date facilities and equipment, and productivity. Not only were such nations as Germany and England well equipped and trained in brass mill production but as a public service our mills at the request of our government received their teams sent over here to learn our methods and brought them up to date on our latest devices and procedures.

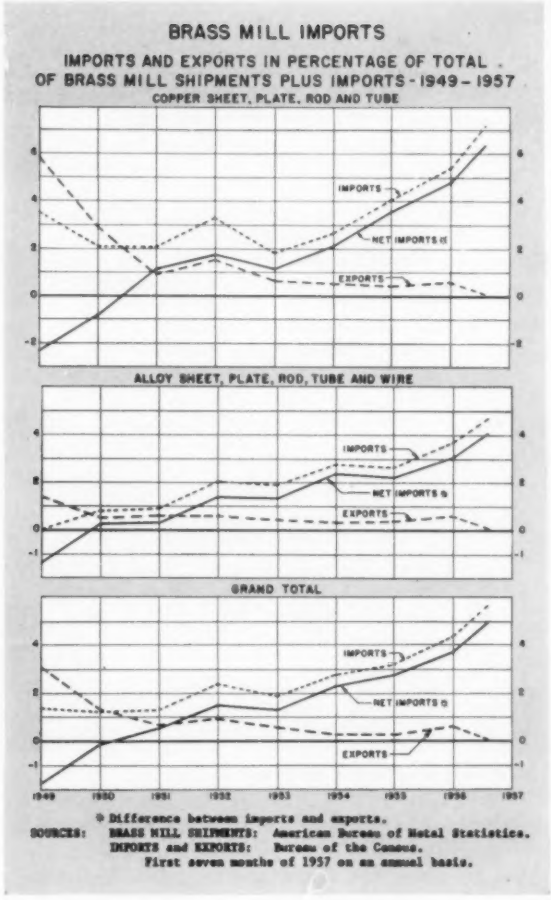
It is often argued that lower wages abroad are offset by lower productivity. For several reasons this argument is not valid. In the first place, in important foreign brass mill product exporting countries, productivity is not nearly as low relative to ours as are wages. Then, too, reliable measures of overall productivity are very difficult to obtain; other factors than direct production labor have to be considered, such as capital costs, overhead rates and administrative and selling costs. Most important, this attempt to make an allowance for lower productivity abroad illustrates the double standard for what is considered fair labor treatment at home and abroad.

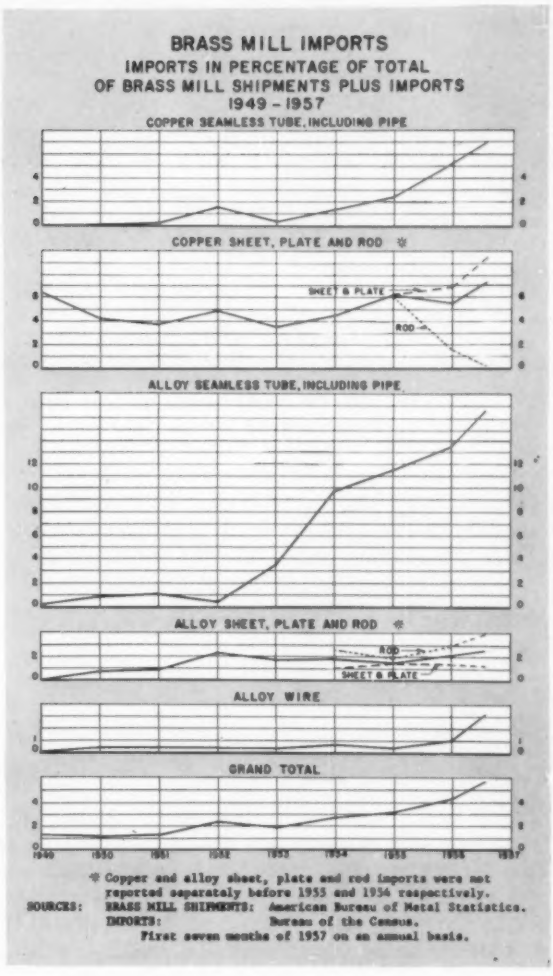
How would our government react to the suggestion that the minimum wage requirement be reduced for domestic concerns which have a low productivity? The entire question of relative productivity is essentially academic. The fact is that important foreign countries can and do undersell our mills in rough proportion to their labor rates.

Our manufacturers would not fear competition with foreign producers who had wage levels comparable with ours. The soundest way to improve the standards of living abroad is to encourage increased wages as labor productivity increases. This process will be expedited if exports to this country must be made on the basis of labor rates comparable to our own — it will not be facilitated by encouraging exports to this country by the underpricing of our products made possible because foreign labor is paid less. We have found in this country that the process of driving labor rates and standards down by price competition based on poorly paid labor is not sound. Why should the process be any sounder if the competition is from abroad?

It has been suggested, perhaps somewhat cynically, that where domestic producers cannot compete with imports, they should convert their facilities to other products. Aside from the fact that in actual practice such a remedy may be as bad as the disease, in the case of the brass mills the government cannot afford to lose domestic capacity to any extent without jeopardizing national security. Such a suggestion also disregards the resultant displacement of valuable, well-trained brass mill workers after many years of good service.

—T. E. VELTFORT
Managing Director
Copper & Brass Research Association


BRASS MILL IMPORTS
IMPORTS AND EXPORTS IN PERCENTAGE OF TOTAL
OF BRASS MILL SHIPMENTS PLUS IMPORTS - 1949 - 1957
COPPER SHEET, PLATE, ROD AND TUBE
IMPORTS
NET IMPORTS *
EXPORTS
ALLOY SHEET, PLATE, ROD, TUBE AND WIRE
IMPORTS
NET IMPORTS *
EXPORTS
GRAND TOTAL
IMPORTS
NET IMPORTS *
EXPORTS
1949 1950 1951 1952 1953 1954 1955 1956 1957
* Difference between imports and exports.
SOURCES: BRASS MILL SHIPMENTS: American Bureau of Metal Statistics.
IMPORTS and EXPORTS: Bureau of the Census.
First seven months of 1957 on an annual basis.


BRASS MILL IMPORTS
IMPORTS IN PERCENTAGE OF TOTAL
OF BRASS MILL SHIPMENTS PLUS IMPORTS
1949 - 1957
COPPER SEAMLESS TUBE, INCLUDING PIPE
COPPER SHEET, PLATE AND ROD *
SHEET & PLATE
ROD
ALLOY SEAMLESS TUBE, INCLUDING PIPE
ALLOY SHEET, PLATE AND ROD *
ROD
SHEET & PLATE
ALLOY WIRE
GRAND TOTAL
1949 1950 1951 1952 1953 1954 1955 1956 1957
* Copper and alloy sheet, plate and rod imports were not reported separately before 1955 and 1954 respectively.
SOURCES: BRASS MILL SHIPMENTS: American Bureau of Metal Statistics.
IMPORTS: Bureau of the Census.
First seven months of 1957 on an annual basis.

scales between here and abroad that have been almost wholly responsible for those inroads.

For instance, a typical example of the impact of imports is shown in the product, seamless brass tube. Import of this totaled 0.96 percent of the total domestic market in 1950. For the first six months of 1957, however, the import of this important type of tube reached about 16 percent of the U. S. market.

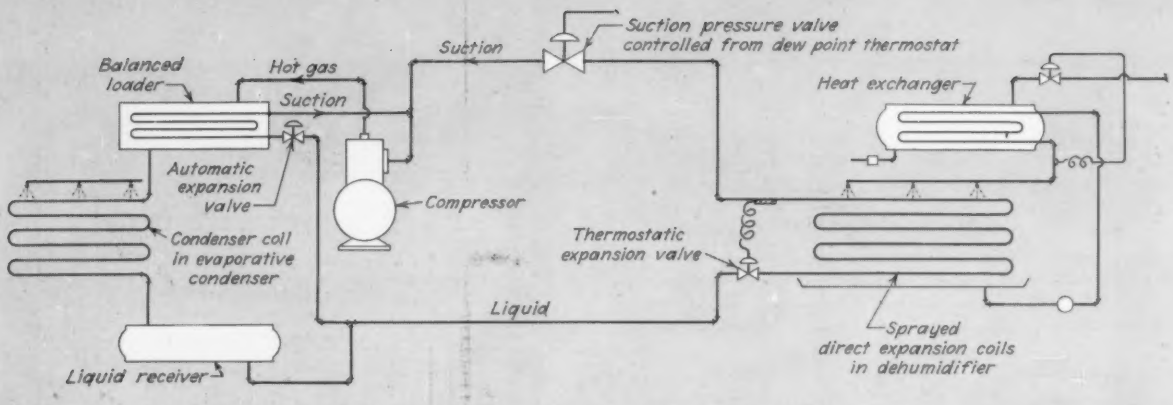
During the 1950-1957 period, the import of copper sheet jumped from 4.3 percent to 8.9 percent of the domestic market. Mr. Veltfort also noted that during the same period the *export* of copper mill products has dropped from 2.91 percent to 0.79 percent of domestic brass mill shipments. Exports of all brass mill products, incidentally, totaled 5.44 percent of domestic shipments in the 1930-1939 period as against 0.66 percent today.

Foreign Wage Rates Way Under Ours

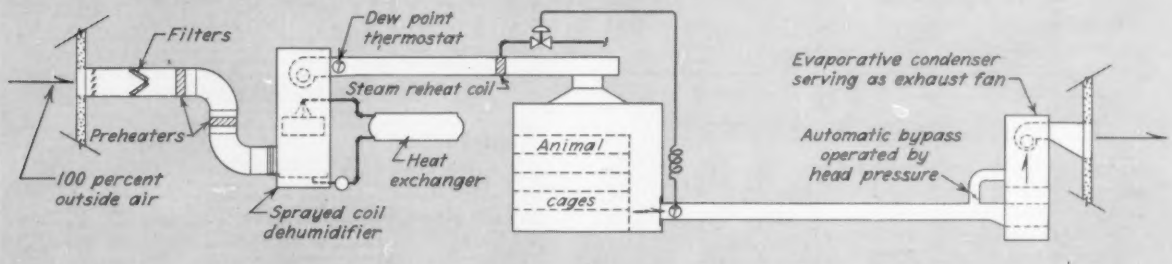
Wage-wise, the domestic brass mill rate of $2.12 per hour (1956 industry average), exclusive of supplementary compensation (fringe benefits), is considerably higher than those of competitor countries. An International Labor Office wage rate table for 1955, for example, indicates an hourly figure of 66 cents for the United Kingdom; Germany, 47 cents; France, 40 cents; Sweden, 90 cents, and Japan 22 cents — as against a U. S. average of $1.88.

Mr. Veltfort emphasized that lower wages abroad are by no means offset by lower productivity. In many cases, he said, brass mill productivity overseas is essentially up to that in the U. S., thanks in great part to training given visiting productivity teams in our own brass mills in the post-war years and the resultant activity abroad in improving productivity.

This productivity, coupled with lower wages and other cost advantages, has enabled foreign producers to sell their ware here for 5 to 25 percent, and more, under domestic prices, Mr. Veltfort continued. Taking random examples, certain types of imported copper tube are quoted at 12 to 15 cents less per pound than the U. S. equivalent; brass tube is offered at 21 cents per lb cheaper, while imported welding rod is quoted at 16 cents per lb below that made by American companies. ≠



1 REFRIGERATION CIRCUIT features sprayed direct expansion cooling coils in dehumidifier under complete modulated control from full load to "featheredge" shutoff. Thus, summer-winter changeover is eliminated



2 100 PERCENT OUTSIDE AIR is used, since no recirculation is permitted. Evaporative condenser for refrigeration cycle serves as exhaust fan. Result is savings in equipment, space

Building expansion, environmental needs . . .

Demand Unique System Design

. . . *for air conditioning animal research lab*

BY ROBERT V. GARNER
Chief Engineer
Frank A. McBride Co.
Heating, Piping, and
Air Conditioning Contractors

CONDITIONS and limitations are occasionally imposed on the designer of an air conditioning system to the extent that the resultant installation incorporates features seldom found or considered in the average system.

For example, some time ago the expansion of an eastern pharmaceutical company had reached the point where its animal research laboratory building was inadequate. It was, therefore, decided to enlarge the existing structure.

Conferences with the research director and representatives of the company's engineering, operating, and maintenance personnel brought out many exacting conditions which had to be met in the design of the new air conditioning system. At the same time, these conferences also afforded opportunity for the designer to urge the adoption of certain design and construction features which he considered essential to satisfactory performance.

Some of the more important conditions which had to be met were as follows:

Conditions imposed by usage:

- Heavy animal load with resultant high rate of air change.
- Cages of animals stacked up to within 1 ft of the ceiling.
- Draftless introduction and circulation of air.
- Individual temperature control in each room or area.
- Close control of temperature in each zone.
- Humidity held within comfort range.

- No cross circulation of air from zone to zone.

Conditions imposed by the design of the structure:

- Unusually low ceilings, to maintain floor levels with the existing structure.
- Overhead fluorescent lighting fixtures.
- Very limited space for equipment.

Conditions urged by the designer, pertaining to the design of structure:

- Minimum use of single glass windows.
- Elimination of direct radiation, if possible.
- Smooth surfaced hung ceilings, free from beams, etc.
- Flush mounted, completely recessed light troffers.

15 Air Changes Per Hour

Calculations indicated that it would be necessary to introduce a large volume of air as low as 58 F and provide as many as 15 air changes per hour to many animal rooms. Many of the animals are very sensitive to drafts and are susceptible to respiratory troubles much the same as human beings.

In addition to faultless distribution of supply air, it was necessary that sudden fluctuations in temperature of the entering air be avoided at all times, even though cooling or heating, or neither, might be needed at any instant. (These systems operate around the clock seven days a week.)

Every effort was made to reduce the volume of supply air to be introduced through the ceiling diffusers. This explains the recommendation for minimum use of single glass, plus shading, where possible. To prevent any downward deflection of the air stream before it mixes with secondary air and spends its force, it was essential that a smooth hung ceiling with recessed light troffers be used.

Exhaust air is drawn off at a safe location near the floor and away from the cages. This is important for winter operation, as no direct radiation is used, it also contributes to a more gentle circulation of the air by eliminating any tendency to short circuit between the diffuser and exhaust grille.

Direct radiation was reduced by doing what could reasonably be done to minimize the need for it in the design of the structure. Its elimination was desired to avoid the problem of controlling it in conjunction with the air conditioning. It was felt that it would be easier and simpler to maintain desired conditions throughout each zone if the supply air only had to be controlled. Each zone generally includes one interior room along with two rooms with exterior exposure.

Individual temperature in each zone is controlled by a pneumatic thermostat, with its bulb in the exhaust duct operating a modulating valve supplying low pressure steam to a reheat coil in the supply duct.

Use 100 Percent Outdoor Air

No recirculation of air was to be permitted. This was to minimize possible spread of airborne organisms from zone to zone, and to avoid recirculation and concentration of animal odors. Therefore, the use of 100 percent air was specified.

For possible economy, methods of purifying the exhausted air to permit recirculation of all or part of it were considered, along with means of air-to-air heat transfer. All were discarded, primarily due to the lack of space available for such equipment and the extra cost and maintenance involved by their use.

Conditioning of the 100 percent outside air follows common practice in being passed through the filters, the preheat coils in two stages, the dehumidifier (sprayed coil), the fan, and then the supply ducts to the zone reheat coils, and finally the ceiling diffusers. Air is also supplied to the corridors to keep them under positive pressure and, at the same time, provide makeup air for that exhausted from the toilet rooms.

Exhaust air in general is picked up as previously mentioned, but the evaporative condenser for the refrigeration cycle is used as the exhaust fan. Costs of equipment and considerable space are thereby saved.

Savings in operating and maintenance costs are also effected through the use of this air for condensing purposes, due to its low wet bulb temperature and its relative cleanliness. Automatic controls permit the air to bypass the condenser coil, as required, to maintain the desired head pressures in the refrigerant circuit.

Provide Modulated Control

One of the interesting features of the system is the use of direct expansion cooling coils in the dehumidifier under complete modulated control from full load to "featheredge" shutoff. Actually, the dew point controller has complete modulated control from full heat to full cooling with no abrupt break at any point in the sequence. Thus, the need for a summer-winter switch or changeover is eliminated.

Since the final results were of utmost concern to all, and that sudden fluctuations in discharge temperature could not be tolerated, it was decided to use a "balanced loader" as part of the refrigeration cycle. Its purpose is to keep the compressor working above atmospheric suction pressure, even though the direct expansion coils are throttled to the point of shutoff.

Essentially, it consists of a heat exchanger, placed in the hot gas line, incorporating its own direct expansion circuit fed by an automatic expansion valve. As the coil in the air handling unit—the dehumidifier, in this instance—is throttled and the suction pressure begins to drop, the automatic expansion valve on the balanced loader begins to open, and keeps the suction pressure in the crankcase up to any desired setting.

In addition to permitting complete throttling of cooling in the dehumidifier while keeping the crankcase pressure up to a safe minimum, it also prevents boiling the oil out of the compressor body, safeguards the lubrication of the shaft seal, and keeps sufficient gas passing through the body to prevent overheating of the body under extremely light loads. ⫩

FIVE NEW BUILDINGS constructed in 3 years enclose more than 2 million cu ft of Mackinac air. Shown left to right are: 450 ft long residence building, mission house, 800 seat theater, Great Hall and dining rooms seating 1000. Behind Great Hall are two colonial style residence buildings

Construction Teamwork

. . . for new five building installation. Structures comprise world assembly center for Moral Re-Armament. Situated on Mackinac Island, heretofore a summer resort, center is designed for year 'round use. Buildings use steam in variety of ways.

STEAM PLANT consists of three high-firebox, stoker fed boilers. Large steam line (upper left), not yet insulated and wrapped, is beginning of 1300 ft artery which connects theater and newest residence building to existing plant

THREE YEARS of winter building has equipped Mackinac Island, an historic summer resort area in the straits between Lake Michigan and Lake Huron, with the world assembly center for Moral Re-Armament. The new center is composed of a dining and assembly building, a theater, and three residences. More than 1000 persons can be accommodated at one time. Representatives from 77 nations met there during the past summer.

Back in September 1954, Moral Re-Armament decided to develop its then 12 year old Mackinac assembly center by construction of an 800 seat theater. Since then three residential buildings have been completed to accommodate 1000 persons and a dining-assembly hall was built.

Heating requirements were that the new buildings must be available for use 12 months in the year, if

THREE MILES of pipe coils were laid in 6 in. concrete floors in Great Hall and five adjoining living and dining rooms. Radiant floor heating is supplemented with warm air from underground ducts discharging through low window sill registers

HOLLOW GRID radiant floor is installed in theater building. Interlocking pans laid at left and right connect to 8 × 3 ft plenum down center of auditorium. Heated air travels both ways in network, is discharged at auditorium sides and rear

Provides for Many Types of Heating

needed, in an area that traditionally had been a summer resort.

The five new units are all heated from one central low pressure steam plant. The plant consists of three high-firebox boilers. These are stoker fed because coal is the most economical fuel on the island. Last winter the plant provided temporary heat during construction and heated existing buildings which together included more than 2 million cu ft. In 10 to 20 F weather the plant used 5 to 6 tons of coal per day.

The induced draft boilers develop 11,000 lb per hr of steam at 100 percent rating. At 150 percent rating the three boilers will develop 16,400 lb per hr. Each unit is equipped with a separate automatic safety feed and low water cutoff.

Low pressure steam from the boilers is distributed in underground insulated lines in one main to separate hot water heat exchangers in two nearby residence buildings which are heated with forced circulation hot water systems.

A second 1300 ft steam line of 8 in. pipe was completed last December, in time to supply temporary heat for the newest residence building then under construction. Construction teamwork produced a roofed building, one-half totally enclosed, so that just after New Year's, work of the entire crew could be done in a steam heated building. Temperatures were kept at 60 F inside when the outside temperature dropped to 10 F.

The steam line and its 2½ in. condensate return were laid in insulated concrete at depths varying from 2 to 6 ft. Because this was laid in near freezing weather, it proved economical to run it through existing basements of two buildings. This reduced excavation and eliminated need for exterior insulation in 200 ft of the line.

Eight corrugated expansion joints were located at intervals along the line in basements and in manholes easily accessible for maintenance. Drip stations were placed at these same points. A modified duplex vacuum pump was installed under the theater building at the approximate midpoint of the return line. The heat exchanger in the residence hall at the far end of the steam line dumps its condensate into a condensate pump which returns it to the vacuum pump. The vacuum pump in turn discharges its condensate into the collection tank in the boiler room.

By close attention to pipe sizing, grading, and insulation, pressure drop in the length of the 1300 ft run was held to approximately 1 lb.

The first unit of the MRA construction program was a theater to be equipped for the presentation of plays. It

was built during the winter of 1954-55 and completed the following summer.

Warm Air Radiant Floor Heats Theater

The 56 × 84 ft auditorium of the theater building has a warm air floor panel heating system. The hollow grid concrete floor is fed through an 8 × 3 ft supply duct with heated air which is delivered into the room at the rear and sides of the auditorium. Thus, a combination panel and convection heating effect is produced. Outdoor and recirculated air for the floor heating system passes through four 48 × 30 ft steam coils.

A maximum of 25,000 cfm of 140 F air may be introduced into the plenum in winter operation at zero F outside. Air travels under pressure through a minimum of 30 ft of what is, in effect, a system of continuous two-way in-the-floor ducts, before being discharged into the auditorium.

Ducts are formed in the concrete floor slab by 26 gage, 1 ft square, steel interlocking pans. They are domed at the center and give 22 in. of duct free area each way when laid 1 ft on centers.

Choose System for Its Flexibility

This type of heating was chosen so the auditorium could remain empty and cold intermittently during the winter, without having to compensate for freezing conditions.

Dressing and public rooms surrounding the auditorium are heated by means of hot water convectors. These smaller rooms are in more constant use, but are kept at only a minimum temperature above freezing when not occupied.

Two squirrel cage fans exhaust 3000 cfm of air when the auditorium is fully occupied. The balance of the air is recirculated. When winter audiences have been small, exhaust fans have not been used. The amount of air exhausted is balanced with the outdoor air intake manually, and settings can vary from full recirculation in winter to 100 percent outdoor air and full exhaust.

Outdoor air intake and exhaust summer operation requires an additional fan which is in the theater basement. This is connected to a bypass in the return air duct system. Return air to the main fan is fully dampered off manually when this fan is operating.

The theater roof is supported on exposed trusses made of 16 in. Norway pine logs and is composed of 2 in. roof boards on log purlins. Fiber board insulation, ¾ in. thick, and composition shingles cover the roof boards.

The theater was originally heated with a stoker-fed, hot water boiler. In subsequent building the steam line from the new main steam plant to the newest residence building was located so that it would pass directly through the theater basement. A heat exchanger was added at this point. With minor changes in the piping, which included reversing the flow of hot water in the system because of the relocation of the plant, the old boiler was disconnected. It is planned that it will be used to replace three smaller hot water systems in the older buildings, which are used by permanent personnel of Moral Re-Armament.

Heating System Put to the Test

The fall of 1955 brought an interesting unscheduled test of the heating plant. An evening program brought island residents to the theater. During the program, snow fell and a strong wind arose. At the end of the performance the audience went to the exits to find high winds up to 50 mph in gusts. One of the area's worst blizzards had settled in for the night. Warm and comfortable inside, no one had realized what was occurring. The heating system had operated satisfactorily and has since without incident.

Following an MRA summer assembly in 1955, work was begun on two new residence buildings and on the Great Hall, which consists of spacious living and dining rooms designed to seat 1000 people at one time, plus kitchen facilities. These three buildings, totaling about 1 million cu ft, were completed in August, 1956.

Convert Steam for Hot Water Heating

The residence buildings are heated by hot water. Low pressure steam from the central boiler plant enters a heat exchanger to provide hot water heating in separate equipment rooms for each residence building. Both buildings are single zone, piped with a reverse return upfeed system. The piping can be drained in the equipment rooms in case of shutdown.

Convectors are installed in each of the 50 bedrooms of the two buildings, as well as in sitting rooms. Heating in the hallways is supplied by cast iron baseboard and by convectors.

Uses Radiant Floor, Plus Perimeter Warm Air

Radiant floor heating, supplemented by warm air perimeter heating, was chosen for the Great Hall. Patterned after the theater, this building combines Mackinac's traditional white siding exteriors with unusual exposed log rafter beams and log trusses inside. The meeting room has 50 ft, 16 and 18 in. logs neatly dapped into one another, bolted together, and rising to a 40 ft peak off the floor. This room has three massive stone fireplaces.

The radiant floor heating system for the Great Hall consists of 1 in. iron pipe on 12 in. centers in a 6 in. concrete slab. Hot water heated by steam is the heating medium. Each dining room has separate radiant floor panels which are independently controlled by an automatic, three-way mixing valve. Each floor panel is arranged for reverse-return supply. The meeting room is divided into four zones, and each dining room is a separate zone.

Overall, the radiant piping system for this building consists of more than 3 miles of serpentine pipe coils.

25 CIRCULATION PUMPS activate 25 separate heat zones in 230 room residence building. Each zone may be separately shut down for repair, has individual thermostatic controls operable from basement for occupied, unoccupied zone status

The kitchen and service rooms are in the center of the building. These are surrounded on four sides with dining rooms, entrance lobby, and lounge rooms. Each room has extensive glass areas, totaling 1800 sq ft, generally facing south.

Provide for Rapid Temperature Changes

Rapid changes in temperature can occur in the dining rooms when the sun comes out suddenly on a cloudy, cold day, and reflects off the lake or shines directly into some of the windows. Quick counteraction to these outside changes is achieved through manual and automatic adjustment of outdoor and recirculated air brought into the perimeter diffusers, as well as in temperature adjustment of air at the main supply fan. Fifty percent outside air is used to supply 20 cfm per person at peak loads. Air is distributed through underground and basement ducts to low window sill louvers which blanket lakeside picture windows and exterior walls.

Low winter humidity is counteracted by admitting low pressure steam into the main air supply duct. A motorized valve shuts off the steam when the main supply fan is turned off.

Air balance is achieved in the system by supplying the kitchen with heated air from a separate fan and exhausting a larger quantity of air from kitchen and service rooms, thus using the excessive air pressures supplied at the perimeter of the building, only a portion of which is recirculated. This has effectively prevented kitchen odors from reaching dining and other surrounding rooms.

The newest residence hall, begun in September 1956 and fully occupied in June 1957, is a 450 ft long brick, block, and native stone building. It has 230 double bedrooms and 150 baths, spacious lounges, and a full basement.

Supply Circulating Hot Water to 25 Zones

The building is divided into 25 zones for heating with forced circulating hot water. Each zone is supplied by a circulating pump, operated by separate zone thermostats through a central panel in the basement. When there is only partial occupancy of any floor or wing of the building, a different temperature setting is made between occupied and unoccupied zones of the building by operating switches in the boiler room. Each zone is independent for repair.

System water temperature is electronically reset over a given range of temperatures as the outside temperature varies.

The ground floor of this building, on or below grade, is heated with high capacity finned tube wall radiation. This floor is used for reception rooms, lounge areas, and offices.

Cast iron radiant baseboard was chosen for bedrooms and baths.

The architect was William O. Woollett. The mechanical engineers for the newest residence hall were Vernon C. and James Dean. Stockly and Bamford were the mechanical engineers for the other buildings and the low pressure steam plant. ∓

HPAC Services:

SOLUTION PIPING to and from filters and pumps in Oldsmobile bumper plating plant is typical of automation's dependence on modern piping services

TODAY's industrial thinking and planning can be summed up in one word — automation. It is encountered everywhere that sizable operations are found.

What effect does this have on the heating, piping, and air conditioning industry? The mechanical contractor has tended to feel that this trend has little to do with his own business. Perhaps this is because little of the work in his field involves mass production. Each job has required an individualized approach.

The truth is, without him there is no automation. Whether he knows it or not, he has been right in the midst of it for years — installing the necessary heating, piping, and air conditioning equipment that makes automation a reality. In one respect, his industry is the workhorse of automation. In another, it has made work for him.

What is Automation?

Automation may be defined as any system or process wherein, in response to any selected kind of changing condition or stimulus, a control is actuated to perform a predetermined action affecting another body or force without specific human intervention. Without heating, piping, or air conditioning services, in some form or other, this does not occur.

Probably the most automated city in the world is Detroit. This industrial capital has automation personified in many applications — paced, of course, by the automotive industry. Here are found huge installations calling for many miles of specialized piping to do a single job, many processing tanks, controls, and, of course, the plants must be heated and, in certain applications, air conditioned.

$1 Million Worth of Piping

The Oldsmobile plant at Lansing, Mich., may be taken as the prototype of new developments in plating installations. This is an automobile bumper plating plant only. Installed in 1953-54, it was designed to include the maximum of automation in the intricate series of processes involved. The progress of bumpers through the plating operations is almost entirely automatic, except at a few transfer points.

Here, close control of time and temperature of the various solutions and stages of plating are of paramount importance.

The cost of the piping work alone came to over $1 million. The system, extending over an area of 140,000 sq ft, includes 62,010 ft of steel pipe of various sizes, in a total of approximately 20 miles of piping of all types.

The plant contains 43 separate plating tanks, including 22 for copper plating, 11 for nickel, and 10 for chrome.

The Workhorses of Automation

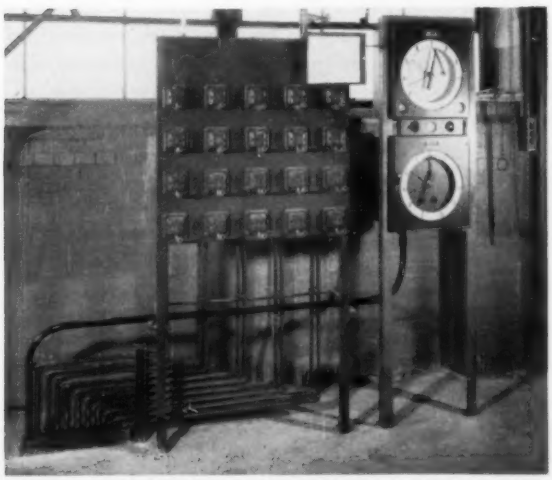
Automation is the byword of today's industry. Without the heating, piping, and air conditioning engineer and contractor there would be no automation. His place in this growing field is described here

Some of these exceed 100 ft in height. In addition, there are numerous auxiliary tanks in the total installation.

The system includes four refrigeration machines with a total capacity of 400 tons, four replacement air units with 200,000 cfm capacity, 20 spray exhaust units with an aggregate capacity of 435,000 cfm, and 62 heat exchangers.

The mechanical work of the installation is closely coordinated with the total operating procedure. It consists chiefly of the basic steam, water, and drain piping and the control of temperatures of the various solutions involved in the processes, storage tanks to feed the main system, and the system of filtering and transferring the solutions used. It is a complex system of tanks serving a variety of special purposes, with individual conditions which must be carefully controlled. This includes wash tanks with spray headers to spray the bumpers passing through them, solution tanks, and acid dip tanks. Each tank is supplied with water and drain piping as required.

Air piping is also required in some of the plating tanks. Headers are usually placed in the bottoms of the tanks, and air is forced through them by blowers, serving to keep the contained solutions uniform in consistency and to prevent any tendency toward stratification.



HYDRAULIC PIPING to central position where hydraulic valves are located shown here. Valves control various storage tanks located below

Temperatures of the various solutions have to be controlled within fairly close tolerances. Here is where the system of heat exchangers becomes effective.

The nature of the solutions used in plating often requires special piping. Plastic pipe and plastic lined pipe are used extensively on most of the recent plating installations, due to their corrosion resistance characteristics.

Hydraulic operation of the basic plating machinery is common in this type of installation. At Oldsmobile there are 11 hydraulic units requiring about 6000 ft of hydraulic tubing. This equipment is used to perform various mechanical functions, principally the raising and lowering of the parts into the tanks, and some of the transfer operations.

For ventilating purposes, an elaborate exhaust ventilation system is installed at Oldsmobile, amounting to at least half the cost of the piping installation.

All modern plants are incorporating some type of year 'round air supply units, as well as extensive exhaust units. Strong efforts by industrial management to remove all sources of air contamination are resulting in better working conditions and improved equipment and plant maintenance conditions.

Cleaned Air Protects Equipment

An example of the emphasis on maintenance conditions was the enclosing of the motor-generator room in the Oldsmobile plating plant within a glass partition with a special air filtering system. This was done to protect the moving parts from dirt and dust, which would cause excessive wear. Also, dirt could accumulate to the point where it could cause short circuits. The obvious danger here is that if a short circuit occurred, the whole mechanical system would probably be stopped. And in a highly automated, mass production manufacturing process, downtime can be very expensive.

In modern steel mills in the Detroit area this factor

is very important. The power requirements are heavy, and it is often necessary to provide for standby facilities.

The rooms containing motor-generator sets are supplied with cleaned air from an air filtering system which reduces the amount of dust and dirt in the air. In some large mills, electrostatic precipitators have been installed to remove the dirt, and the firms have found it well worth the cost in resultant savings in repairs and loss of time.

One steel company, not one of the largest in the area, is planning for an air supply system to cost about $30,000. This will filter the air supply as well as control the temperature in the motor-generator room. The temperature problem can be serious here, since temperatures up to 130 F are sometimes experienced in the summer. The controls are planned to keep this to a maximum of 95 F. The proposed installation will have a capacity of 40,000 to 50,000 cfm.

Serve Auto Engine Manufacturing

Another outstanding development in automation is in automotive engine production, as in the Ford engine plant in Cleveland. In this area, too, mechanical contracting serves an essential part.

In the Ford plant the installation cost of piping for the fuel, lubrication, cooling water supply and return, and engine exhaust came to about $100,000.

The lines were laid underground and covered before the floor was poured, with outlets provided for each engine test stand. This is a fairly representative piping installation for a complex production installation involving an intricate product.

A still more intricate type of basically similar installation is required for a jet engine test unit. Each of the many connections involved in each test stand is piped back to a central control room which is equipped with instruments to record the results of each engine test.

Typical of the amount of mechanical work required for automation was the installation at Oldsmobile for a jet engine plant in 1951-53. The piping contract was for $500,000 and involved individual piping for about 3000 machine tools, each incorporating the latest developments in automation designed for a specific purpose.

This included a variety of piping requirements, with each machine tool needing several different types of piping, according to its nature. This included quench oil, compressed air, water, steam, and hydraulic piping, with the necessary return provisions.

A heat treating furnace, of which there are several types installed at Oldsmobile, might require gas, air supply, and cooling water supply for the bearings, and air for the temperature control devices. Overhead conveyors and hoists each required compressed air and lubrication piping.

Automated Air Conditioning

Specialized air conditioning controls in connection with automatic production processes are found in other industries. For instance, a plant built several years ago by Parke, Davis and Co. for production of antibiotics involves another aspect of automation in one of the world's largest pharmaceutical plants.

Critical human service is another field where automation has taken hold. At the Henry Ford hospital, Detroit, a new 17 story building to house the outpatient clinic and operating rooms has service features that are as fully automatic as possible. It is, figuratively, a plant for the production of health.

In addition to its elaborate pushbutton operation of various medical services, the institution is completely air conditioned. All air passes through electrostatic precipitators for elimination of all possible foreign matter. Temperature is automatically controlled throughout the building. In the operating rooms, especially rigid controls are maintained and the controls are set to secure a considerably higher relative humidity in order to eliminate build-up of static electricity.

The entire structure involves an elaborate maze of mechanical equipment. The installation was made at a cost of $4½ million.

The Overall Picture

The various installations and applications that have been touched on here are, of course, mere drops in the bucket, when compared to the overall picture. Needless to say, there are numberless more.

Automation is the key to progress — to the mass production that makes this nation grow both industrially and economically. The preponderance of heating, piping, and air conditioning equipment necessary to make these processes function makes the position of the heating, piping, and air conditioning engineer and contractor very apparent. He is truly the workhorse of automation.

And he likes it that way. ⫩

L.A. Industries Switch To Gas on Smoggy Days

. . . to reduce air pollution

NATURAL GAS is being substituted for fuel oil by Los Angeles area industries to reduce air pollution on days of heavy smog, the Los Angeles Air Pollution Control District reports.

Upon a signal from the APCD that alert conditions are forecast, industrial users switch to natural gas, thus reducing by about 500 tons total pollution being emitted daily.

Gas is stored underground in depleted oil fields, and is allocated for smoggy days, although the total supply of gas available for the area has not been increased. ⫩

Sam Lewis' Page

"I Converted These Systems To Forced Circulation Hot Water"

The author relates some of his experiences in deciding to convert.

FREQUENTLY I am called to diagnose and prescribe remedies for vapor heating systems. The old thermostatic steam traps have been neglected, the alternating receivers on other appliances usually have worn out, and the air eliminators no longer eliminate, or if they do eliminate, they also regurgitate.

In many cases repairs for the obsolete equipment cannot be obtained. I approached a radical cure for the first one, some time ago, with trepidation, but now I tackle almost any one of them with confidence, and convert them to forced circulation hot water.

SAMUEL R. LEWIS, *consulting mechanical engineer and a member of HPAC's board of consulting and contributing editors, comments informally each month on practical heating, piping, and air conditioning problems.*

In most cases no changes at all in the piping are necessary. Sometimes the old trap bodies can remain, with the interior mechanisms discarded and with the trap orifices removed or reamed larger.

It is comparatively easy to remove most of the trimmings and to install an expansion tank and automatic refill device and to provide a water circulating pump.

This converted system seems to give universal satisfaction. Perhaps it may not be so very much better than was the original vapor system when the latter was new, but it certainly is a far better heating plant than the vapor system after the latter became leaky.

I even had nerve enough to convert a 32 apartment, four story, steam heating system to forced circulation hot water, and have had pleasant experience with its operation.

This plant had an adventurous history. Originally it was a two pipe, thermally circulating, hot water system, with enormous flow and return pipes and an expansion tank in the attic.

The boiler was at one end of the building nearly a block from the other end, and the plant evidently was sluggish in circulation. The apartments most distant from the boiler always were cold. From the mute evidence of its physical condition, the original plant was inadequately designed and badly installed.

After some years of trouble, the owner was advised by some unknown party, to make a gravity steam job out of it. He installed hundreds of air valves, and the occupants endured for many years the continual snapping and pounding, leaks and repairs, inherent to a poorly graded, badly drained steam piping system.

I found three old electric pumps, which had been installed and abandoned at various times, in attempts by successive owners and contractors to correct the difficulties.

We arranged a simple centrifugal circulating pump and a large pneumatic expansion tank and made a very few changes in the basement outgoing main pipes. The large incoming return mains, long used for condensate, which trickled along their bottoms, were channeled in some places as though the liquid they carried had been strong acid.

There were hardly any radiator valves which could be closed or opened, and all valves were minus the original handles. However, this plant ultimately made over, as a forced hot water system, is eminently satisfactory. It heats evenly and quietly and probably will last many years. ⧺

The Law and Your Profits

BY WILLIAM HURD HILLYER

Mechanic's Lien is Delicate Mechanism

VENDOR'S LIENS often stand in the way of mechanic's liens, much to the frustration and disappointment of the heating, piping, and air conditioning contractor. Protection of the contractor's just compensation calls for careful wording of requirements, as a recent case demonstrates.

Contractor E. Quippum undertook in writing to make extensive improvements on the premises of the San Toreador Motel. In addition to installing the piping for a swimming pool, the specified job included the installation of *sufficient* air conditioning units, together with the necessary wiring, "to completely and adequately air condition all buildings, rooms, and parts of buildings connected with" that motel.

The then owners gave Quippum a mechanic's lien (designated as a third lien) contract securing a $25,000 note payable in monthly installments of $250 each.

Meanwhile, the motel was sold and there was executed to the purchaser a vendor's (fourth) lien to secure the payment of a $50,000 purchase money note.

The motel consisted of 36 room areas, plus an office and a cafe. Quippum installed 16 air conditioning units, which, in the owners' estimation, was an inadequate number.

The sole consideration for an agreement to subordinate the vendor's lien for $50,000 to the mechanic's lien for $25,000 was Quippum's undertaking to make the improvements as set forth in the mechanic's lien contract.

E. Quippum, to raise cash, had assigned the mechanic's lien and note to Lenda, a financier. Following a year's default, during which time no payment of principal nor interest was made, the purchaser of the property brought suit to subordinate the mechanic's lien to vendor's lien against Lenda, as the mechanic's lien holder.

District court entered judgment for the plaintiff and against Lenda. Lenda thereupon appealed.

The civil court of appeals ruled that the jury's finding was supported by the evidence; to wit, that the installation of air conditioning equipment in 16 of the motel's unit areas did not adequately air condition all buildings, as had been set forth under the contract agreement.

The higher court was also of the opinion that the contractor was not entitled to any recovery upon a *quantum meruit* (literally, what he deserves), for reasonable value of work actually performed and materials furnished. Such recovery, the higher court pointed out, is possible only under the following conditions:

"Where, after a partial performance, further performance is prevented by the owner; where the owner is guilty of a breach which justifies the contractor in refusing further to perform; where both parties have broken the contract; where there has been a mutual abandonment by both parties; where further performance is prevented by a cause for which neither party is responsible and which excuses further performance by both parties; where there has been a partial performance and an acceptance by the owner, of benefits arising therefrom; where the owner accepts . . . and uses work which does not comply with the contract.

"On the other hand," the court continued, citing applicable law, "unless the work is shown to be of benefit to the owner or to have been accepted by him, the contractor is not entitled to recover on a *quantum meruit* for work done under an indivisible contract; or where, after partial performance, he wrongfully has abandoned the contract, or failed or refused to complete the work without any fault on the part of the owner; or where the completed work does not comply with the terms of the contract."

In a word, the contractor, under such circumstances, gets nothing at all.

After due consideration the court of civil appeals overruled all the points of the contractor and affirmed the trial court's judgment in favor of the plaintiff.

From a practical standpoint, the trouble with this case was engendered by the negligent wording of the mechanic's lien contract, which, instead of specifying the number of air conditioning units called for, was content to deal in generalities—thereby leaving it wide open to controversy as to what consituted *sufficient* air conditioning.

A mechanic's lien is a delicate mechanism. Being a statutory creation outside the common law, it is strictly construed and, to be effective, must be very strictly worded. ±

WILLIAM HURD HILLYER, *author of this regular feature, is a contributor to a number of banking and financial publications and has written several books on business. He has an extensive practical legal and financial background.*

This series presents actual cases. Naturally, laws vary in different states. All names are fictitious.

Approve Chicago's New Ventilation Code

THE NEW Chicago ventilation code, completely revised to keep abreast of new developments and new requirements for ventilation of commercial and industrial occupied spaces, is presented in full on the following pages.

Effective as of November 18, 1957, the code includes many new provisions for eliminating unhealthy and hazardous conditions in industrial applications. The code was last amended in 1947, but it had not been completely revised since 1939 as the desired changes could be accommodated previously by means of amendments.

The industrial ventilation requirements are outlined specifically in Table B on pages 104, 105, and 106. Table A contains the requirements for commercial ventilation. The special committee responsible for the preparation of the new code, under the administration of Mayor Richard J. Daley, is given on page 110.

It is felt that this new ventilation code will be the forerunner of similar codes for other cities. Its presentation in this issue gives HPAC readers the "first look."

Municipal Code of the City of Chicago

Chapter 81 — Ventilation

Be It Ordained by the City Council of the City of Chicago:

SECTION 1. Chapter 81 of the Municipal Code of Chicago is amended to read as follows:

CHAPTER 81.

VENTILATION.

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81- 3. Methods of producing ventilation
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81- 5. Area of ventilating openings

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81-22. Adjustment of air supply and exhaust
81-23. Instruments for taking readings
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81-25. Method of making readings
81-26. Determining quantities of air and area of openings

Operation of ventilation systems

81-27. Time and manner of operation

Inspection and test of ventilation systems

81-28. Notice for test and letter of approval

Violation of Chapter provision

81-29. Penalty

General Provisions.

81-1. Ventilation is hereby defined as the providing and maintaining in rooms or spaces, by natural or mechanical means, air conditions which will protect the health and comfort of the occupants thereof.

81-2. The installation of all ventilating systems provided for in this code shall be done in conformity with the provisions of this chapter.

The ventilating requirements, as herein stated, shall apply to every room hereafter designed, erected, altered, or converted for the purposes enumerated.

Openings required by hazardous room purposes, to remove heat or gases which may accumulate, for fire prevention, and for any other cause except health and comfort of the human occupants of the rooms shall be provided as required by other chapters of this code.

See Note 5—Industrial Work Shops.

81-3. Ventilation may be produced by:

(a) A natural ventilating system which is hereby defined as a ventilating system, the effectiveness of which depends upon natural atmospheric conditions and upon the operation of windows, transoms and other openings, the operation of which is in control of the person or persons in the room or space which is ventilated.

(b) A mechanical ventilating supply system, which is hereby defined as a system for forcing air into a room or space by artificial means combined with the removal of air through windows, skylights, transoms, undercut doors, grilles, shafts, ducts, or other relief openings direct to outside except as provided in section 81-15 (e).

(c) A mechanical ventilating exhaust system, which is hereby defined as a system for removing air from a room or space by artificial means combined with a supply of air through windows, skylights, transoms, grilles, shafts, ducts or other relief openings direct to outside except as provided in section 81-15 (e).

81-4. Ventilating openings in any room or space are hereby defined as apertures opening upon a public way, yard, court, public park, public waterway, or onto a roof of a building or structure in which the room or space is situated. They shall be windows, skylights, transoms, or other openings which are provided for ventilating purposes and which are equipped with adjustable louvres, dampers, or other devices to deflect or diffuse the air currents. French

windows and doors shall be considered to be ventilating openings in living quarters.

81-5. The area of ventilating openings shall be computed as follows:

Windows. The maximum area that can be opened.

Skylights. The area of the maximum opening to the outer air, provided that it does not exceed the area of the sashed openings to the outer air, or the area of the skylight well. If this area exceeds either the area of the sashed openings or the skylight well, the smaller area is the ventilating area.

Transoms. The free area through the sashed opening if the transom swings through an arc of not less than sixty degrees. It is the same percentage of the free area as the maximum angle of the transom when open is to sixty degrees if the transom swings through an arc of less than sixty degrees.

Auxiliary Ventilating Openings. The free area when louvres, dampers, or other devices are in position to deflect or diffuse the air currents in such a manner that there will be no objectionable drafts.

In addition to windows, skylights, and transoms, relief openings (R.O.) as used in section 81-7, table A, shall be construed to be any duct that connects a room to the out of-doors and terminates above the roof. It shall be of sufficient cross-sectional area to convey an equivalent quantity of air to that of the mechanical supply or mechanical exhaust for the room at a velocity not to exceed 800 fpm. If the duct shall be equipped with a grille, the free area of the grille shall be sufficient to convey the same quantity of air at a velocity not in excess of 500 fpm if the grille is below 7′-0″ or in excess of 600 fpm if the grille is 7′-0″ or more above the floor. The termination of the duct shall be equipped with a stormproof louvre, cowl, or other equipment opening having an outlet free area not smaller than that of the duct.

The duct may be equipped with a gravity type damper permitting air flow in one direction only; or with an automatic damper arranged to close only whenever the fan serving the room is not running or both.

Ventilation Requirements.

81-6. The ventilating requirements shall be based on the purposes for which the rooms are used, regardless of the class of building or structure in which it is located.

The method of producing ventilation and the quantities of air to be supplied and exhausted by mechanical ventilating systems stated in the tables in section 81-7 are the minimums permitted. Where it is stated that natural ventilation is required, this may be supplemented but not replaced by a mechanical ventilating supply system or a mechanical ventilating exhaust system, or both. However, the full requirements must be met by natural ventilation.

81-7. Table of Ventilating Requirements.

TABLE A.

Room Purpose	*Conditions* — Area of ventilating openings in percentage of floor area: Less than	Not less than	*Requirements* — Minimum C.F.M. supply or exhaust per square foot of floor area, except as otherwise noted. S indicates mechanical supply. E indicates mechanical exhaust. R.O. indicates relief opening. N.R. indicates no requirement.	*Other Conditions*
Anaesthetizing rooms			S 1.2 and E 1.2	
Animal rooms			E 1.5	
Aquariums			N.R.	
Armories		5	N.R.	
	5		S 0.8	
Art galleries			S 0.6	
Auditoriums, except those used for worship only			S 3.0 and E 1.5 in open spaces having no fixed seats plus S 30, and E 15, for each fixed seat.	Capacity 601 or more persons.
		5	S 3.0 in open spaces having no fixed seats plus S 30 for each fixed seat and R.O.	Capacity 600 or less persons.
	5		S 3.0 and E 1.5 in open spaces having no fixed seats plus S 30 and E 15 for each fixed seat.	Capacity 600 or less persons.
Auditoriums used for worship only		3	N.R.	
	3		S 1.5 and E 0.75 or S 1.5 and R.O.	
Autopsy Rooms			S 1.5 and E 3.0 or E 3.0 and R.O.	
Ball rooms			Same as for "Dance halls"	
Band rooms			Same as for "Reading rooms"	
Banking rooms (public and teller spaces)			S 1.2 and E 1.2	Stories below that nearest to grade

TABLE A.

Room Purpose	*Conditions* Area of ventilating openings in percentage of floor area: Less than	Not less than	*Requirements* Minimum C.F.M. supply or exhaust per square foot of floor area, except as otherwise noted. S indicates mechanical supply. E indicates mechanical exhaust. R.O. indicates relief opening. N.R. indicates no requirement.	*Other Conditions*
		5	N.R.	Other Stories
	5		S 1.0 or E 1.0	
Bank vaults attended			S 1.0 or E 1.0	
Banquet halls			S 2.0 and E 1.5	
Beauty parlors		5	N.R.	
	5		S 1.2 and E 1.2	
Billiard rooms		5	N.R.	
	5		S 1.6 and E 1.6	
Board of Trade Trading rooms			S 1.5 and E 0.75	
Book stack rooms			Same as "Storage rooms"	
Bowling alleys		5	No requirements	
	5	3	S 3.0 in open spaces having no fixed seats plus S 30 for each fixed seat. or E 3.0 in open spaces having no fixed seats plus E 30 for each fixed seat	Disregard floor area from foul line to pit.
	3		S 3.0 and E 3.0 in open spaces having no fixed seats plus S 30 and E 30 for each fixed seat.	
Brokers board rooms			Same as for "Board of Trade (trading rooms)"	
Cabarets			Same as for "Dance halls"	
Cafeterias			Same as for "Dining rooms in which there is cooking equipment, public"	
Chapels			S 1.5 and E 0.75 or S 1.5 and R.O.	
Chart rooms			Same as for "Offices"	
Class rooms			S 1.5 and E 0.75 or S 1.5 and R.O.	
Class rooms, for religious instruction exclusively		5	N.R.	
	5		S 1.5 and E 0.75 or S 1.5 and R.O.	
Class rooms in private schools		8	N.R.	
	8	5	S. 1.5 or E 1.5	
	5		S 1.5 and E 0.75 or S 1.5 and R.O.	
Closets			N.R.	
Coat rooms			N.R.	
Coat check rooms			N.R.	
Community halls			S 1.5 and E O.75 or S 1.5 and R.O.	
Concert halls			Same as "Auditoriums except those used for worship only"	
Conservatories			N.R.	
Convention halls			Same as for "Auditoriums except those used for worship only"	
Cooking rooms for instruction purposes only		5	E 1.2	
	5		S 1.0 and E 1.2	
Corridors			N.R.	
Council chambers			Same as for "Auditoriums except those used for worship only"	
Court rooms			Same as for "Auditoriums except those used for worship only"	
Dance halls		5	S 3.0	
	5		S 3.0 and E 2.0 or S 3.0 and R.O.	
Delivery rooms			Same as for "Operating rooms"	
Dining rooms in which there is no cooking equipment, public		5	N.R.	
	5	1	S 1.5 or E 1.5	
	1		S 1.5 and E 1.5	
Dining rooms in which there is cooking equipment, public		1	E 2.0	
	1		S 1.5 and E 2.0	

TABLE A.

Room Purpose	*Conditions* Area of ventilating openings in percentage of floor area: Less than	Not less than	*Requirements* Minimum C.F.M. supply or exhaust per square foot of floor area, except as otherwise noted. S indicates mechanical supply. E indicates mechanical exhaust. R.O. indicates relief opening. N.R. indicates no requirement.	*Other Conditions*
Doctors' and dentists' examination rooms			Same as for "Offices"	
Dormitory rooms			Natural ventilation	
Dressing rooms		5	N.R.	
	5		S 1.0 and E 1.2	
Dressing rooms, residential			N.R.	
Exhibition rooms			S 1.5 and E 0.75 or S 1.5 and R.O.	
Exposition rooms			Same as for "Exhibition rooms"	
Foyers in theaters			S 2.0	
Foyers in transient hotels			S 1.5 and E 0.75 or S 1.5 and R.O.	
Foyers in club houses and residential hotels		5	N.R.	
	5		S 1.0	
Foyers, except in theaters, club houses and residential hotels			N.R.	
Fraternal halls			S 1.5 and E 0.75 or S 1.5 and R.O.	
Game rooms			Same as for "Billiard rooms"	
Garages, 5 or more cars			E 1.0 and S 0.75 or E 1.0 and R.O.	
Garages, less than 5 cars			1 sq. ft. R.O. per car	
Garage vestibules			N.R.	If floor area is less than 25 sq. ft.
apartment buildings office buildings			S 0.6	If floor area is more than 25 sq. ft.
Green rooms			Same as for "Dressing rooms"	
Grills			Same as for "Dining rooms in which there is cooking equipment, public"	
Gymnasiums		5	No requirements	
	5		S.8 to which the following shall be added if seats are provided for spectators. S 2.0 and E 1.0 or S 2.0 and R.O. in open spaces with no fixed seats and S 20 for each fixed seat.	
Halls (corridors)			N.R.	
Instruction rooms not otherwise specifically noted			Same as for "Class rooms"	
Janitors' closets			Same as for "Toilets"	
Kitchens, public		3	E 4.0	
	3		S 1.2 and E 4.0	See section 80-11
Kitchens, having a floor area of less than 125 square feet			Same as for "Living quarters, kitchens"	
Laundries, containing equipment which can be used by more than one family at one time but not serving the general public		2½	N.R.	
	2½		E 1.0	
Lecture rooms			Same as for "Community halls"	
Libraries			Same as for "Reading rooms"	
Linen rooms			Same as for "Storage rooms, active storage"	
Living quarters			Natural ventilation	Sitting rooms, living rooms, parlors, and other rooms of similar use; dining rooms and bed rooms.

TABLE A.

Room Purpose	*Conditions* Area of ventilating openings in percentage of floor area: Less than	Not less than	*Requirements* Minimum C.F.M. supply or exhaust per square foot of floor area, except as otherwise noted. S indicates mechanical supply. E indicates mechanical exhaust. R.O. indicates relief opening. N.R. indicates no requirement.	*Other Conditions*
			Natural ventilation	Kitchens having a floor area of more than 125 square feet.
		5	N.R.	
	5		E 1.5	Kitchen having a floor area of less than 125 square feet.
Lobbies			Same as "Foyers"	
Locker rooms		5	N.R.	
	5		E 1.2	See section 81-19
Lodge halls			S 1.5 and E 0.75 or S 1.5 and R.O.	
Lounges			Same as for "Smoking rooms"	
Lunch counters and lunch rooms			Same as for "Dining rooms"	
Morgues			Same as for "Autopsy rooms"	
Museums			Same as for "Art gallery"	
Musicians' rooms			Same as for "Dressing rooms"	
Natatoriums			Same as for "Gymnasiums"	Disregard area of swimming pool
Offices		5	N.R.	
	5		S 0.6 and E 0.3 or S 0.6 and R.O.	
Offices, reception			Same as for "Reception rooms" in connection with offices	
Operating rooms			S 1.2 and E 1.2	
Patients' rooms			Natural ventilation	
Physiotherapy			Same as for "Offices"	
Picture galleries			S 0.6 or E 0.6	
Police station cell rooms		5	N.R.	
	5		S 1.2	
Pool rooms			Same as for "Billiard rooms"	
Projection rooms				See section 88-540.3
Property rooms			Same as for "Storage rooms"	
Reading rooms		5	N.R.	
	5		S 1.2 and R.O.	
Reception rooms in connection with offices				If ventilating openings having 5% of floor area of intermediate room are located in the partitions separating said room from another room having ventilating openings not less than 5% of the floor area of both rooms and if ventilating openings having 2½% of floor area of intermediate room are located in wall or corridor.
			N.R.	
			S 1.0 or E 1.0	If ventilating openings of less area than noted above are located in either wall above mentioned.

TABLE A.

Room Purpose	Conditions: Area of ventilating openings in percentage of floor area — Less than	Conditions: Area of ventilating openings in percentage of floor area — Not less than	Requirements: Minimum C.F.M. supply or exhaust per square foot of floor area, except as otherwise noted. S indicates mechanical supply. E indicates mechanical exhaust. R.O. indicates relief opening. N.R. indicates no requirement.	Other Conditions
Reception rooms, except in connection with offices			Same as for "Foyers in club houses and residential hotels"	
Recreation rooms			Same as for "Gymnasiums"	
Rest rooms		5	N.R.	
	5		S 1.0 and E 1.0 or S 1.0 and R.O. through locker or toilet rooms	
Safe depositories			Same as for "Banking rooms (public and teller spaces)"	
Sales rooms		5	N.R.	
	5	2.5	S 0.5 or E 0.5	
	2.5		S 1.0 and E 1.0 or S 1.0 and R.O.	
Serving rooms and pantries	5	2	E 2.0	
	2		S 1.2 and E 2.0	
Shower rooms			E 1.0	
Skating rinks, ice		5	N.R.	
	5	4	S 1.8 and E 0.9	
	4	3	S 1.8 and E 1.2	
	3	2	S 1.8 and E 1.5	
	2		S 1.8 and E 1.8	
Skating rinks, roller			Same as for "Dance halls"	
Sleeping rooms (except sleeping stall rooms and rooms otherwise specifically noted)			Natural ventilation	
Sleeping stall rooms		5	N.R.	
	5		S 0.5 and E 0.5	
Slop sink rooms			Same as for "Toilets"	
Smoking rooms		5	N.R.	
	5		S 1.0 and E 1.5	
Solariums		5	N.R.	
	5		E 1.0	
Stage hands rooms			Same as for "Dressing rooms"	
Studios, motion picture, radio and television, audience type			S 1.5 and E 0.75 or S 1.5 and R.O.	
no audience type			S 1.5 and E 0.75 or S 1.5 and R.O.	
clients rooms			S 1.5 and E 0.75 or S 1.5 and R.O.	
control rooms			Same as for "Offices"	
Study rooms			Same as for "Class rooms"	
Sunday school rooms			Same as for "Auditoriums used for worship only"	
Sun rooms			Same as for "Solariums"	
Teaching amphitheaters, (instructors' spaces)			S 1.2 and E 1.2	
Teaching amphitheaters, (spectators' spaces)			S 3.0 and E 3.0 in open spaces with no fixed seats and S 30 and E 30 for each fixed seat	
Toilet rooms		5	N.R.	
	5		E 2.0	
Toilet rooms, residential		5	N.R.	
	5		E 1.5	
Treatment rooms			Same as for "Offices"	
Urinal rooms			Same as for "Toilet rooms"	
Ushers' rooms			Same as for "Dressing rooms"	

TABLE A.

Room Purpose	Conditions: Area of ventilating openings in percentage of floor area — Less than	Conditions: Area of ventilating openings in percentage of floor area — Not less than	Requirements: Minimum C.F.M. supply or exhaust per square foot of floor area, except as otherwise noted. S indicates mechanical supply. E indicates mechanical exhaust. R.O. indicates relief opening. N.R. indicates no requirement.	Other Conditions
Vault, storage			N.R.	
Vault, safe depository			Same as for "Safe depositories"	
Vaults, bank, attended			Same as for "Bank vaults, attended"	
Waiting rooms in railway stations and similar occupancies			Same as for "Foyers in club houses and hotels"	
Waiting rooms, except in railway stations and similar occupancies		5	N.R.	
	5		S 1.0 and E 1.0	
Wards			Same as for "Dormitory rooms"	
X-ray operators' rooms			Same as for "Offices'	

TABLE B.

Auto and vehicle washing (continuous)			S 1.0 and E 1.0	See note 5
Auto repair shops			S 1.0 and E 1.0	See note 5
Apparel shops and tailoring		5	N.R.	
	5		S 1.5 and E 1.5	
Bakeries and food	Below Grade		S 1.2 and E 1.0	See section 107-8
		5	N.R.	
baking rooms	5		S 1.2 and E 1.0	
Fermentation rooms			N.R.	
Bananas ripening and storage		2	N.R.	
	2		E 0.4	
Brewing and pasteurizing			N.R.	
Brewing and pasteurizing packaging		5	S 1.0 and E 1.0	See note 2
	5		S 1.2 and E 1.2	
Ceramics, brick, clay, cement manufacturing, and processing		5	S 1.5 and E 1.5	See note 5
	5		S 2.0 and E 2.0	
Cereal manufacturing and packaging		5	N.R.	See note 5
	5		S 1.2 and E 1.2	
Chemical manufacturing and processing		5	N.R.	See note 5 and section 120-7 chapter 60 and 150
	5		S 1.5 and E 1.5	
Chewing gum and diverse departments		5	N.R.	See note 5
	5		S 1.2 and E 1.2	
Coffee roasting		5	N.R.	See note 5
	5		S 1.5 and E 0.5	
Coffee packaging		5	N.R.	
	5		S 1.2 and E 1.2	
Confectionery manufacturing		5	N.R.	See note 5
	5		S 1.2 and E 1.0	
Distilling and rectifying plants		5	N.R.	See note 2
	5		S 1.2 and E 1.2	
Dry cleaning establishments using petroleum distillates		5	E 4.0	See note 5 and sections 60-25, 60-81 and 60-86
	5		S 1.5 and E 4.0	
Dry cleaning establishments using chlorinated hydrocarbons			S 4.0 and E 4.0	
Dyer establishments		5	N.R.	See note 5 and section 60-85
	5		S 1.5 and E 1.5	

TABLE B.

Room Purpose	Conditions: Area of ventilating openings in percentage of floor area — Less than	Conditions: Area of ventilating openings in percentage of floor area — Not less than	Requirements: Minimum C.F.M. supply or exhaust per square foot of floor area, except as otherwise noted. S indicates mechanical supply. E indicates mechanical exhaust. R.O. indicates relief opening. N.R. indicates no requirement.	Other Conditions
Electrical products manufacturing and assembling		5	N.R.	See note 5
	5		S 1.2 and E 1.2	
Enamel, vitreous, synthetic, finishing		5	N.R.	See note 5 and section 60-85
	5		S 1.5 and E 1.5	
Fertilizer manufacturing		5	S 1.0 and E 1.0	See note 5
	5		S 1.5 and E 1.5	
Foundries, ferrous and non-ferrous		5	S 1.0 and E 1.0	See note 5 and chapter 60
	5		S 1.5 and E 1.5	
Fur clothing making		5	N.R.	See note 5
	5		S 1.2 and E 1.2	
Glassware and optical lenses		5	N.R.	See note 5
	5		S 1.2 and E 1.2	
Grain elevators, conveying, shaking, sifting departments		5	S 1.2 and E 1.2	See notes 2, 5 and chapter 60
	5		S 1.5 and E 1.5	
Laboratories		5	N.R.	See note 5 and chapter 60
	5		S 1.2 and E 1.2	
Laundries, serving general public			S 1.5 and E 1.5	See note 5 and chapter 145
Leather goods and product manufacturing		5	N.R.	See note 5
	5		S 1.0 and E 1.0	
Loading spaces and appurtenant driveways			N.R.	See note 3 and note 6
Machine shops		5	N.R.	See note 5
	5		S 1.0 and E 1.0	
Malt houses			Same as for "Brewing and pasteurizing packaging"	See note 2
Matches manufacturing		5	S 1.0 and E 1.0	See note 5 and chapter 60
	5		S 1.5 and E 1.5	
Packing houses, meats and food processing		5	N.R.	See chapter 171 See note 4
	5		S 0.6 and E 0.6	
Paper products and specialties		5	N.R.	See note 2 and note 5
	5		S 1.5 and E 1.5	
Paints and lead products manufacturing and processing		5	N.R.	See note 5 and chapter 60 and chapter 150
	5		S 1.0 and E 1.0	
Paraffin, pitch, tar, resin and similar processing		5	S 1.0 and E 1.0	See note 2 and note 5 and chapter 60
	5		S 1.5 and E 1.5	
Paving material manufacturing		5	N.R.	See note 2 and note 5
	5		S 1.0 and E 1.0	
Pharmaceuticals and drugs, etc. manufacturing		5	N.R.	See note 2 and note 5 and chapters 60 and 150
	5		S 1.5 and E 1.5	
Photo materials and engraving		5	N.R.	See note 2 and note 5
	5		S 1.0 and E 1.0	
Plastics manufacturing and molding		5	S 1.0 and E 1.0	See note 2 and note 5
	5		S 1.5 and E 1.5	
Plating, metal		5	S 1.0 and E 1.0	See note 2 and note 5
	5		S 1.5 and E 1.5	
Printing		5	S 1.0 and E 1.0	See note 2 and note 5
	5		S 1.5 and E 1.5	
Rendering plants		5	S 1.0 and E 1.0	See note 2 and note 5 and chapter 171
	5		S 1.5 and E 1.5	

TABLE B.

Room Purpose	Conditions: Area of ventilating opening in percentage of floor area — Less than	Conditions: Area of ventilating opening in percentage of floor area — Not less than	Requirements: Minimum C.F.M. supply or exhaust per square foot of floor area, except as otherwise noted. S indicates mechanical supply. E indicates mechanical exhaust. R.O. indicates relief opening. N.R. indicates no requirement.	Other Conditions
Roofing material manufacturing		5	N.R.	See note 2 and note 5 and chapter 165
	5		S 1.5 and E 1.5	
Rubber goods manufacturing		5	N.R.	See note 2 and note 5
	5		S 1.5 and E 1.5	
Smelting and metal refining		5	N.R.	See note 5 and chapter 60
	5		S 2.0 and E 2.0	
Soap manufacturing		5	N.R.	See note 2 and note 5
	5		S 1.5 and E 1.5	
Spray finishing, vitreous and non-vitreous		5	N.R.	See note 5 and 7 and chapter 60
	5		S 1.5 and E 1.5	
Spray booths				See note 5 and 7 and chapter 60
Steel mills		5	N.R.	See note 5 and chapter 60
	5		S 2.0 and E 2.0	
Storage, inactive			N.R.	See section 59-2 (a)—(b) concerning active and inactive. See note 4
Storage, active		2	N.R.	
Storage, active	2		S 0.5 or E 0.5	
Storage, cold (no permanent occupancy)			N.R.	
Tanneries		5	N.R.	See note 5
	5		S 1.0 and E 1.0	
Textile mills, cotton, wool, silk and synthetics		5	S 1.0 and E 1.0	See note 5
	5		S 1.5 and E 1.5	
Tobacco, cigar and cigarette manufacturing		5	N.R.	See note 2 and note 5
	5		S 1.5 and E 1.5	
Varnish manufacturing plants		5	N.R.	See note 2 and note 5
	5		S 1.0 and E 1.0	
Vehicles, body manufacturing plants and auto repair shops			S 1.0 and E 1.0	See note 5 and sections 48-9.3 and 59-3.1
Work shops not otherwise classified		5	N.R.	See note 5
	5		S 1.2 and E 1.2	
Wood working shops		5	N.R.	See note 2 and note 5
	5		S 1.0 and E 1.0	

The ventilating requirements for rooms used for purposes similar to those enumerated in the foregoing tables but not specifically named therein, shall be the same as those for room purposes of similar character.

Where, in the foregoing tables, requirements for room purposes are stated as "N.R." (no requirements), rooms or spaces used for the designated purposes shall be subject to all general provisions applicable thereto.

The minimum quantity of air supplied to or exhausted from a room shall be fifty cubic feet per minute.

Notes.

Note 1. Cab stands for cabs using internal combustion engines. If driveways and other apertures open directly to atmosphere, said apertures having an area not less than twenty percent of the floor area of the cab stand—No requirement.

If apertures have an area of less than twenty percent of the floor area of the cab stand—Ventilation shall be provided to comply with section 81-27 and note 3.

Note 2. In rooms or departments of any factory, used for food products processing, brewery, malt processing or mill, in which rooms, large floor area and space occupying closed tanks, vats, or closed food processing equipment or kettles are permanently installed, leaving a reduced unoccupied floor area and work space for a few occasional employees serving as process attendants and watchers, the minimum ventilating requirements given in the foregoing tables shall be adjusted and determined to conform to the following:

(a) Rooms in which the total area of ventilating opening is five percent (5%) or more than the employees' net work floor area—Natural Ventilation.

(b) Rooms in which there are no ventilating openings or less than five percent (5%) of the employees' net work floor area—S 1.0 C.F.M. per square foot of net work floor area.

Note 3. Passages (enclosed) for vehicles using internal combustion engines.

If openings, each having an area not less than 25 percent of the cross-sectional area of the passage, are provided to the atmosphere in both end walls of the passage—Natural Ventilation.

If openings having a combined area not less than than 50 percent of the area of a side wall of the passage, uniformly distributed, are provided to atmosphere—Natural Ventilation.

Note 4. Refrigerated rooms.

The table of minimum ventilation requirements does not apply to any mechanically refrigerated rooms or areas necessarily used and required to carry on an aging process, or for similar requirements, or for the storage and preservation of the products, meats, food and beverages. When such refrigerated rooms or areas are not used for human occupancy, they shall be considered as, no requirements. See section 59-2.

Note 5. Work shops.

When the work in the room is of such character that dangerous or noxious dust, fumes, mists, gases, odors or other contaminants harmful to workers are given off, the requirements as stated in the foregoing tables shall be supplemented by local mechanical exhaust sufficient to remove the emission at the source and to prevent the escape of such contaminants to the occupied space; and to discharge such mechanical exhaust to the outdoor atmosphere. Such mechanical exhaust shall be provided with suitable means for the collection and removal of the contaminates. The total air supplied from out-of-doors shall be equivalent to, or greater than the total air volume removed by the general and local exhaust systems.

Note 6. Loading spaces and appurtenant driveways.

(Interior) Loading spaces and appurtenant driveways in manufacturing, storage or mercantile units, having doors opening directly to the atmosphere at each loading space, where the loading dock is raised at least 36 inches above the adjacent driveway and the doors are situated not over 65 feet from the dock shall require no ventilation openings, provided that the dock area is separated from the interior of the unit by a wall or doors or a combination of both.

(Exterior) Where loading docks are constructed with the floor of dock not less than 36 inches above the adjacent driveway, which driveway is not enclosed, and where at least 20 percent of the lineal footage of the total external walls, or 50 percent of the lineal footage of the largest external wall of the dock consists of loading doors—No requirement.

Note 7. Cabinet spray booths.

Cabinet spray booths for which the exhaust requirement per code does not exceed 5000 C.F.M., indirect air supply to the booth from the adjacent area shall be permitted, provided that the maximum volume of air exhausted does not exceed the equivalent of 1½ air changes per hour within the adjacent area.

81-8. If the air condition in any habitable room becomes objectionable due to causes other than the occupancy by human beings and the commissioner of buildings finds that the health and comfort of the human occupants is endangered thereby, additional ventilation by natural or mechanical means, approved by the commissioner of buildings shall be provided.

81-9. The air supply for every ventilating system, either natural or mechanical, shall be taken directly from out-of-doors, except that:

(a) When air is supplied by a mechanical ventilating supply system, a portion of the code required air supply may be recirculated, provided the system is equipped with such devices for control of temperature, and dust content in the spaces to be ventilated and that the conditions of the air so supplied, (except as to temperature) are substantially the same as though all of the supply air were taken from out-of-doors. The portion or volume of air so recirculated may be considered as exhaust from the room from which it is withdrawn. Under such conditions, not less than thirty-three and one-third percent of the code requirements shall be taken from out-of-doors by the mechanical ventilating supply system; and sixty-six and two-thirds percent of the code requirements may be recirculated air, plus any additional air volume of system design capacity in excess of code requirements. A greater portion of the code-required air may be recirculated, provided the system is also equipped with effective adsorption devices so that the conditions of the air so supplied (except as to temperature) are substantially the same as though all of the supply air were taken from out-of-doors. Under such conditions, not less than fifteen percent of the code requirements shall be taken from out-of-doors by the mechanical ventilating system; and eighty-five percent of the code requirements may be recirculated air. Where adsorption equipment is used, means for maintaining the effectiveness of the adsorption process shall be provided. All equipment shall be so arranged that at least fifty percent of the required air supplied by the system may be taken from out-of-doors. The outside air intake shall be so arranged that at least one hundred percent of the required air supplied by the system can be taken from out-of-doors

(b) When air is supplied by a mechanical ventilating supply system which is not equipped with devices prescribed in paragraph (a) then only such portions of the air volumes of the system design capacity in C.F.M. that exceed the total code requirements in C.F.M. may be recirculated during the time of room occupancy. The air intake and all equipment and ducts shall be so arranged that all of the code required air supplied by the system can be taken from out-of-doors, with provisions made for release or exhaust of such air to the atmosphere.

(c) The intake drawing air from out-of-doors shall be at such a point that the air supply will be uncontaminated and that the openings will be unobstructed at all times. The intake opening shall be not less than fifteen feet from the discharge outlet of any exhaust fan. Unless adequate means is provided for the removal of dust from the air, the bottom of the opening shall be not less than ten feet above the surface of any abutting public way, gangway, driveway, grade, or abutting roof. No intake opening shall be placed in a horizontal position in any sidewalk, or in the pavement of any street, alley, or driveway, or within twelve inches of the level of any other surrounding grade; nor so as to take air

from the lower level of any two level street or similar construction.

(d) No air exhausted from bath, toilet, urinal, or similar room, lavatory, locker, coat room, kitchen, boiler room, or rooms of similar use in which such air might be contaminated by smoke, gases, or dust which might be noxious, dangerous, or detrimental to health shall be recirculated at any time; except that air exhausted from locker and coat rooms or kitchens may be recirculated when unoccupied.

81-10. (a) The air inlets and outlets in every system of ventilation, either natural or mechanical, shall be so located and constructed as to insure, when said systems are properly operated, circulation of air throughout each room.

(b) Reasonable precaution shall be taken in the design and installation of the system to prevent the air from striking the occupants of the room under such conditions as to cause discomfort.

(c) If a mechanical ventilating supply system only is installed for a room, or if a greater quantity of air is supplied by a mechanical ventilating supply system than is removed by a mechanical ventilating exhaust system for a room, adequate means shall be provided for the natural exit of the excess air suppllied. If a mechanical ventilating exhaust system only is installed for a room or if a greater quantity of air is removed by a mechanical ventilating exhaust system than is supplied by a mechanical ventilating supply system for a room, adequate means shall be provided for the natural supply of the deficiency in the air supplied.

81-11. The air removed by every mechanical ventilating exhaust system shall be discharged out-of-doors at a point where it will not cause a nuisance, and from which it cannot again be readily drawn in by a ventilating system, excepting that:

Air which is to be used for recirculation may be discharged to a supply system.

Air which will not cause a nuisance may be discharged into a boiler room in such quantity as is required to supply the needs of combustion.

81-12. Mechanical exhaust from bath, toilet, urinal, locker, service sink closets and similar rooms, shall be independent from those for rooms of other character. Exhaust from such rooms may be connected to the same exhaust system provided that none of the air is recirculated and that the exhaust fan shall be in operation all of the time that the building is occupied.

Mechanical ventilating exhaust systems for all rooms shall be independent from those for bath, toilet, urinal and similar rooms, except that:

Exhaust ducts from all rooms may be connected to and made a part of the exhaust for toilet, bath and urinal rooms, provided:

(a) That the exhaust fan for the system is in operation all of the time that the building is occupied;

(b) That the branch duct from each room or group of rooms shall be run parallel and adjacent to the duct from toilet, bath or urinal rooms for a distance of not less than five feet, within which distance there shall be no exhaust openings in either duct, and the connection between the ducts shall be made with an easy curve having its outlet toward the exhaust fan, and

(c) That the total quantity of air exhausted from such rooms shall not exceed ten percent of the capacity of the fan, and

(d) That the ducts from food preparation and food consuming spaces, shall not be connected to exhaust systems serving toilet, bath or urinal rooms, and

(e) That no air from such exhaust systems shall be recirculated at any time.

81-13. If an installation is a mechanical ventilating exhaust system without a mechanical ventilating supply system, or if it is a mechanical ventilating supply system, either with or without a mechanical ventilating exhaust system, the equipment shall be sufficient to warm makeup air from —10° F. to a temperature of 70° F.

81-14. The materials used in every mechanical ventilating air supply and air exhaust systems shall be of sheet steel or other approved materials. Materials shall be non-absorbent and of moisture resisting character, which will not burn, char, or contribute to the intensity of fire flame spread when in contact with fire. This requirement does not apply to air filters as used for air filtering systems, and acoustic material as used inside ducts for sound adsorption.

The design and construction of all equipment and the weight and bracing of all duct work shall be such as will operate under all conditions without causing vibration. Ducts and acoustical duct lining shall be substantially air-tight.

Interpretation of Requirements.

81-15. In rooms which are required to be provided with mechanical ventilating exhaust systems, either with or without mechanical ventilating supply systems, the outside air to replace the air exhausted from each room shall be obtained from ventilating openings in that room, or from a mechanical ventilating supply system installed for that room, except:

(a) In foyers, living quarters, offices, rest rooms, lobbies, locker rooms, medicine rooms, and picture galleries, it may be obtained from (1) openings from uncontaminated rooms adjacent to designated rooms, through wall openings having a free area not less than one percent of the floor area of the designated rooms, provided the area of the ventilating openings is not less than five percent of the combined floor areas of the adjacent room and the designated room; or

(2) from a mechanical ventilating supply system serving rooms adjacent to the designated room, either alone or in combination with the designated room, provided that there are openings having a total area not less than one percent of the floor area of the designated room between such adjacent rooms and the designated room, and that the quantity of air supplied to the adjacent rooms is not less than that required for both the designated room and the adjacent rooms.

(b) In public kitchens and serving pantries it may be obtained through ventilating openings in each of said rooms, from dining rooms adjacent to the designated rooms, provided the area of the ventilating openings in the dining room is not less than five percent of the combined floor area of the dining room and the kitchen or serving pantry. The air exhausted from the dining room through these ventilating openings into the kitchen shall be considered as mechanical exhaust for

the dining room, under the requirements of this code; and the kitchen exhaust need not be increased over the requirements of section 81-7 provided that it exceeds the exhaust requirements of the dining room.

(c) In banking vaults in connection with banking rooms and safety depositories it may be obtained from natural ventilating openings in adjacent uncontaminated banking spaces provided the area of the natural ventilating openings is not less than five percent of the combined floor area of the banking spaces and the vault or from a mechanical ventilating supply system serving the adjacent banking spaces, provided that the quantity of air supplied to the banking spaces is not less than that required for both the vault and the banking spaces.

(d) In bath, toilet, and urinal rooms, check rooms, storage rooms, storage battery rooms, and other rooms of similar character, it may be obtained from ventilating openings in the rooms, or from openings to uncontaminated rooms adjacent to the designated rooms which have ventilating openings equal to one percent of the floor area of the designated rooms or which are provided with a mechanical ventilating supply system of the capacity required for the adjacent rooms, provided that the quantity of air supplied to the adjacent rooms is not less than that exhausted through the designated rooms.

(e) In rooms with mechanical supply, air may be exhausted through openings to corridors or other uninhabited rooms, provided the rooms being supplied do not contain dangerous or noxious fumes, odor or dust and provided that there are adequate R.O. or mechanical exhaust in such adjacent corridors or uninhabited rooms.

81-16. If the installation includes an air cooling system, or if, for any other reason it is impracticable to open the ventilating openings, the ventilation requirements shall be the same as though no such openings were provided.

81-17. It a room is used for two or more room purposes, having different ventilating requirements, and it is possible to determine the space which will be used for each purpose, each such space may be considered as a separate room and ventilated in accordance with the table of ventilating requirements; if it is not possible to determine the space which will be used for each purpose the entire room shall be ventilated as required for the most severe room purpose in the room.

81-18. A partition which stops a distance of two feet or more below ceiling level shall not be considered a partition forming an independent room, but the space on both sides of the partition shall be considered as one room. Grilles having openings of not less than seventy-five percent free area may be placed in the two foot space. Height of doors shall not be considered part of the partition.

81-19. Exhaust from locker rooms may be withdrawn through grilles into adjacent toilet rooms, provided that the total exhaust from the toilet room shall equal the sum of the exhaust requirements for both rooms.

81-20. In office spaces composed of general office areas and private offices, the exhaust for the private offices may be taken through relief openings into the general office space, provided that the exhaust for the general office space equals the total exhaust required for the entire space.

Method of Determining Compliance.

81-21. Plans shall be submitted with permit application for approval, and shall show major details of proposed ventilation systems, with air-quantities computed according to the requirements of section 81-7 of this code. Such plans, except for structural provisions or alterations, may be certified and sealed by a professional engineer registered in the State of Illinois.

81-22. In testing ventilating systems for fan capacity, the system shall be considered in compliance if the air quantities for air supply and air exhaust meet or exceed the air quantities required by tables 81-7A and 81-7B of this code.

In testing ventilating systems for distribution the system shall be considered in compliance if the air quantities for air supply or air exhaust meet or exceed the air quantities required by the approved plan.

81-23. Compliance with mechanical ventilating requirements shall be determined by readings indicating the velocity of the air in feet per minute; they shall be taken with a calibrated anemometer unless the conditions surrounding the installation are not within the range of accuracy of this instrument, in which case a Pitot tube, or other device approved by the commissioner of buildings shall be used.

81-24. Readings shall be taken at the openings, except where these are inaccessible or if accessible only at great hazard, and where the design or construction of the openings is such as to make it impossible to determine the free area.

81-25. Readings shall be taken by holding the anemometer close to the face of the opening and moving it at a uniform rate of speed over the entire surface of the opening. If the area of the opening is more than one hundred forty-four square inches and the velocity of air is not approximately uniform over the entire area, the opening shall be subdivided into equal areas, the longest side of which shall not exceed twelve inches and each subdivision shall be considered as an independent opening, and the average velocity of all of the subdivisions shall be considered as the velocity through the opening.

If the openings are inaccessible or if accessible only at great hazard or if the design or construction of the openings is such as to make it impossible to determine the free area, readings shall be taken over areas as hereinbefore described through handholes placed in the branch duct behind each opening or as close as practical to the opening.

81-26. Measurement of air quantities flowing into or out of an opening shall be determined by the following methods:

(a) The velocity readings as indicated by the anemometer shall be corrected to conform to the calibration curve for the instrument used.

(b) Measurement of air flowing into a free opening shall be determined by multiplying the corrected anemometer velocity by the area of the opening.

(c) Measurement of air flowing into an opening equipped with a device such as a grille, register, louver, screen or coil, shall be determined by multiplying the corrected anemometer velocity by eighty-five percent of the gross area of the device.

(d) Measurement of air flowing into an opening less than four inches in any dimension shall be made by using an adapter with an anemom-

eter as well as a K factor which has been established by a test method approved by the commissioner of bulidings. The air quantity shall be determined by multiplying the corrected anemometer velocity by the factor for the particular adapter.

(e) Measurement of air flowing out of a free opening shall be determined by multiplying the corrected anemometer velocity by the area of the opening.

(f) Measurement of air flowing out of an opening equipped with a device such as a uniform flat surfaced grid, grille, or register shall be determined by multiplying the corrected anemometer velocity by the average of the gross area and the net free area of the device.

(g) Measurement of air flowing out of an opening equipped with a device such as a non-uniform non-flat surfaced grid, grille, register or diffuser, or an opening less than four inches in any dimension, shall be made by using an adapter with an anemometer as well as a K factor which has been established by a test method approved by the commissioner of buildings. The air quantity shall be established by multiplying the corrected anemometer velocity by the factor for the particular adapter.

(h) The sum of the quantities of air delivered at all the openings of a system shall be considered the total capacity of the fan at the speed at which readings are taken.

Operation of Ventilating Systems.

81-27. Every ventilating system, either natural or mechanical, shall be kept in good repair and in operation so as to insure the required ventilation of all rooms and spaces to be ventilated thereby during all hours of human occupancy. No ventilating system shall be operated so as to cause objectionable drafts upon occupants.

The ventilating system in every garage and every passage for vehicles, using internal combustion engines, shall be operated at such times and in such a manner that the amount of carbon monoxide in the air in the garage or passage shall not exceed a maximum concentration of one part in ten thousand parts of air.

Inspection and Test of Ventilation Systems.

81-28. The inspection of mechanical ventilating or air conditioning systems shall be made as soon as possible after the person responsible for the installation and adjustment and test of the system has notified the commissioner of buildings in writing that the system has been adjusted and tested and is in good operating condition and that it fulfills all the requirements prescribed herein, and if such test is found to fulfill the requirements contained in this ordinance, the commissioner of buildings, upon written request, shall issue a letter of approval to the owner or the contractor who made the installation.

Violation of Chapter Provisions.

81-29. Any person violating, or resisting or opposing the enforcement of any of the provisions of this chapter, where no other penalty is provided, shall be fined not more than two hundred dollars for each offense. Every day such violation shall continue shall constitiute a separate and distinct offense; and any builder or contractor who shall construct any building in violation of the provisions of this chapter, and any architect or engineer who shall design, draw plans for, or have supervision of such building, or who shall permit it to be constructed, shall be liable for the penalties provided and imposed by this section.

SECTION 2. This ordinance shall become effective upon its passage and due publication.

The special committee responsible for the preparation of the new code, headed by John Dolio, partner in the firm of Shaw, Metz, and Dolio, architects and engineers, general chairman, is:

a) Commercial Section

William Goodman, consulting engineer, Chairman [Mr. Goodman is a member of HPAC's board of consulting and contributing editors.]

E. P. Steinberg, architect

S. I. Rottmayer, consulting engineer, representing the American Society of Heating and Air-Conditioning Engineers

A. H. Cronin, representing Sheet Metal Workers Union No. 73

L. L. Narowetz, sheet metal contractor, representing the Ventilating and Air Conditioning Contractors Association

C. R. Kuglin, consulting engineer, representing the Chicago Association of Consulting Engineers

b) Industrial Section

E. P. Heckel, consulting engineer, Chairman, representing the American Society of Heating and Air-Conditioning Engineers [Mr. Heckel is a member of HPAC's board of consulting and contributing editors.]

M. D. Kalisher, architect, representing the American Institute of Architects

Silas Cartland, consulting engineer, representing the Chicago Association of Consulting Engineers

S. J. Troutman, representing Sheet Metal Workers Union No. 73

P. R. West, sheet metal contractor, representing the Ventilating and Air Conditioning Contractors Association

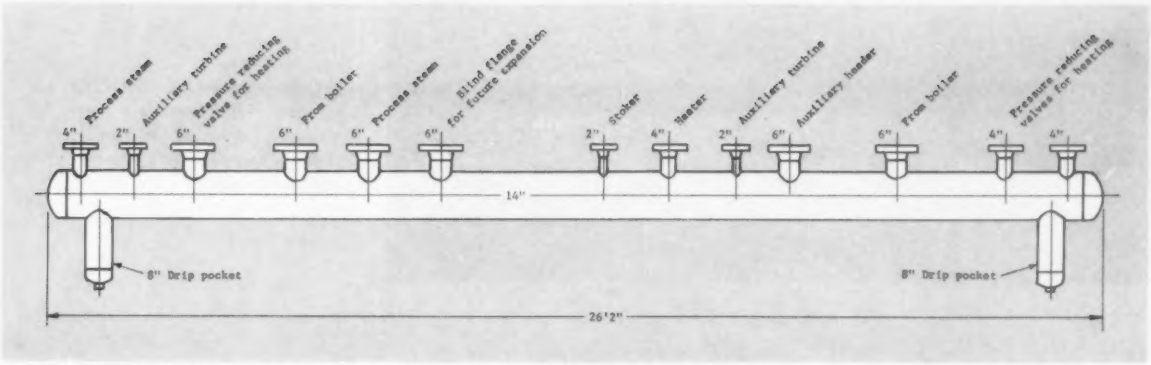
Rudolph Houkal, consulting engineer, representing the Chicago Association of Consulting Engineers

c) Ex officio members (all of the City of Chicago)

John J. Aeberly, chief, Bureau of Heating, Ventilation, and Industrial Sanitation

A. H. Zimmerman, assistant chief, Bureau of Heating, Ventilation, Industrial Sanitation

Richard L. Baran, chief, Div. of Industrial Hygiene and Hazardous Use Control ‡



1 MAIN STEAM HEADER installed in industrial plant has a 6 in. blind flange which can be easily replaced by a valve to serve additional line for future change

Provide for Future Piping Connections

BY G. W. HAUCK
Manager, Engineering Sales
Crane Co.

MANY TIMES piping that was installed in the past poses a problem when it becomes necessary to add an inlet or outlet connection. If provision for the future has been made in the original planning, shutdowns often can be avoided. Headers serve as excellent examples.

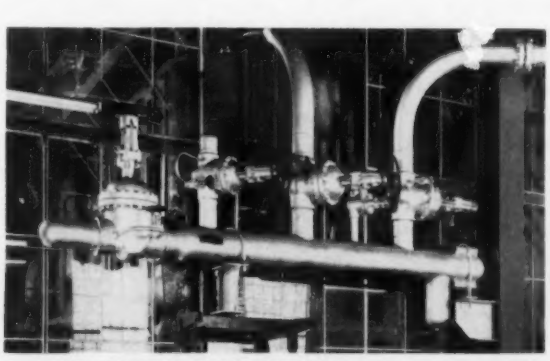
The 14 in. steam header for 150 psig at 366 F, shown in Fig. 1, was installed in an industrial plant in 1953. The sixth nozzle from the left is 6 in. in diameter, with a blind flange for future work. This is likely to be very useful whenever the need arises for an additional connection to this header. The header need only be shut down long enough to remove the blind flange and install a gate valve. This is appreciably less effort and less time consuming than shutting down while a nozzle is being located and welded in place. Added to the latter is the cost of removing insulation and restoring it.

Another header which contains several provisions for future connections is shown in Fig. 2. At the left are two valved connections, one on a welded nozzle, the other on the swedged end of the header proper. When the time arrives for future extensions, no shutdown will occur. Here the valves are the key to uninterrupted service during future construction. Simply remove the welding caps and connect up the new piping.

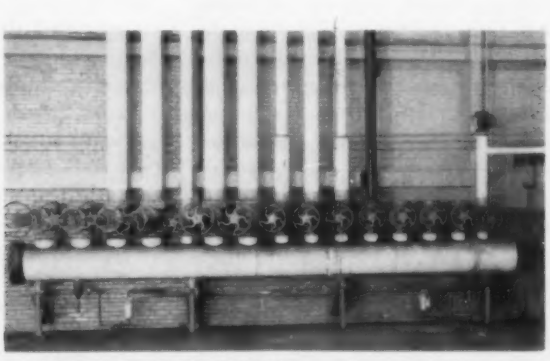
A 16 in., 300 psig header in a very modern industrial plant is shown in Fig. 3. Two of the connections are inlets for steam from the boilers. The balance of the valved connections are for steam service to various sections of the plant. However, five of the connections are for future expansions. Since the valves are in place, there will be no shutdown whenever added connections are needed. Remove the blind flange and you're ready to connect the new piping. ⧺

The author is a member of HPAC's board of consulting and contributing editors and has prepared numerous articles for publication in HPAC.

Other articles on piping hookups will be published in future issues of HPAC. Previous articles were in the September, October, and November HPAC's.



2 TWO VALVED CONNECTIONS at left will permit future extensions without shutdown of header by removing welding caps and connecting new piping



3 FIVE FUTURE EXPANSIONS can be made without shutdown of this 16 in., 300 psig header, since valves with blind flanges are already in place

ZONE CONTROL PANELS regulate ventilation air supply and exhaust in Jeffery Hale's hospital, left, nurses' residence, right

For convenient regulation of heating and ventilation . . .

Individual Zone Control Panels

This is the second and concluding article describing the heating and ventilation systems in the Jeffery Hale's hospital. The first appears in the November HPAC.

BY J. M. PAQUET
Tasse, Sarault & Associates
Consulting Engineers

THE USE of five outdoor bulb type compensators, including three that in addition to regulating temperature also compensate for solar radiation, and a unique central master control console, in the building superintendent's office, are expected to cut fuel costs to a minimum in all heating zones of the new Jeffery Hale's hospital in Quebec City, and its adjoining nurses' residence.

The central control panel is the first of its kind in Quebec, if not the first such panel in Canada. From the console the building superintendent can check room temperatures at 48 locations as well as eight water temperatures. He can further make any necessary corrections on the heating controls from this central panel to allow for any abnormal conditions such as high winds, winter storms, or infiltration.

The compensators are on the penthouse roofs. The hospital has one temperature compensator for the east zone, and both solar and temperature compensators for the front and west zones. The nurses' residence has one temperature compensator for the east zone, and both solar and temperature compensators for the west zone.

The heating system is divided into three main zones for the hospital and two zones for the residence. These again are divided into subzones at each floor of the hospital, from the second floor up to the sixth. The residence has subzones for each of the three upper floors and a separate zone for the basement classrooms.

The heat control panels at each of the five nurses' stations consist of three manual reset switches.

Individual thermostats control the temperature in special rooms such as the operating rooms, the nursery, laundry, main dining room, gymnasium-auditorium, main laboratory, and main kitchen. These thermostats regulate both the heating and ventilation systems.

Humidity controls also are installed in such locations as operating rooms and nursery.

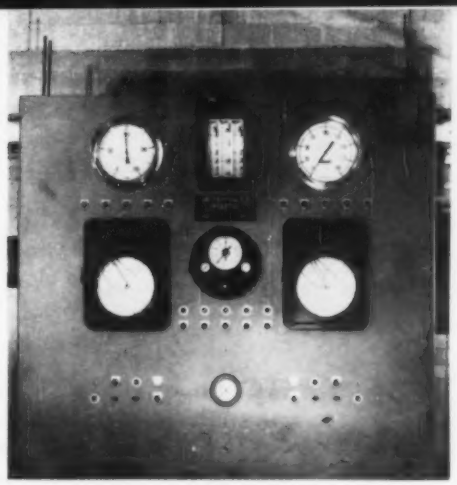
All these controls are electronic.

In addition to the temperature indicators and temperature correction switches, the central panel also incorporates checking switches for all the ventilation systems throughout both buildings, as well as pilot lights that indicate if temperatures are normal or low for the various systems.

Control reset switches, also on the central console, give further adjustment of the effect of the outdoor compensators in the extremely changeable weather conditions of Quebec winters, and in spring and fall seasons when evening temperatures drop suddenly.

Twin water tube boilers have a capacity of 6000 lb of steam per hr each, at 100 psig, with feedwater at 150 F. Each has a heating surface of 1000 sq ft. They supply steam for the hot water heating system for both buildings, to the steam injection hot water supply heaters, to the heating units in the ventilation system, to the laundry, operating room sterilizing units, and other sterilizers located elsewhere.

The twin rotary oil burners use Bunker C oil and are operated by 2 hp motors equipped with magnetic starters, oil solenoid valves, gas pilot, magnetic gas valves, atomizer cup, and a double electrical ignition



METER PANEL in boiler room has indicators and electrical controls for oil burners, steam pressure gages, and switches for oil pumps

Serve New $4 Million Hospital

assembly. Maximum capacity of each is 90 U.S. gph. Metering pumps are fitted to the oil feed lines, and each burner has its own thermometer.

The separate indicator and control panel for the boilers is installed directly facing the boilers. This panel, 80 in. wide × 8 ft high, combines both electrical and pneumatic controls and indicators for the oil fuel and water supply and steam lines of both boilers. It has two boiler meters, with air reset control. There are also two multipointer gages connected to the wind boxes and combustion chambers of each boiler and to the flue gas breeching.

Electrical controls and relays mounted on the panel have cables well protected. Lights and switches are beside the selector valves. Plastic name plates identify all meters, controls, and indicators on the face of the panel.

Two centrifugal type boilerfeed pumps, each having a capacity of 20 U.S. gpm against a head of 290 ft. are driven by 5 hp motors operating on 208 volts, 60 cycle current and controlled by magnetic starters. A single 2 in. hot water meter with an 8 in. dial is installed at the discharge.

A vertical condensation return tank, equipped with a centrifugal pump and 24 × 23 in. receiver, takes care of condensation in the steam supply lines from the boilers to the hot water heaters. The pump has a ½ hp motor, with magnetic starter, and operates at 1750 rpm.

The receiver is for all condensation returns below the level of 190 ft. Other condensation return pumps serve the steam supply lines to the laundry, kitchen, operating room sterilizers, and heating units in the ventilating system. Condensation tanks were installed at strategic locations, but the pumps are concentrated as far as possible in the machinery room beside the boiler room.

Unit heaters serve some areas where extremely variable temperature conditions require them. Some are in the entrance porches at four main doorways, others in the laundry, and the kitchen. Some unit ventilators are in the entrance halls.

Installed in the same room with the water treatment tanks are the heat exchangers for the hot water heating system. The heat exchangers operate at 20 psig.

Secondary hot water systems serve such installations as radiant heating panels in the ceilings of four rooms in the operating room section; heating coils in the ventilation system, and the basement. The 50 gpm heat exchanger for this secondary system supplies water at 190-200 F. Circulating pumps of small capacity serve each of these three zones separately.

The main part of the hot water heating system in most rooms of the hospital and nurses' residence consists of finned pipe convectors.

The radiant heating panels in the ceilings of the operating room sections are suspended in level position from galvanized wire attached to anchor clips imbedded in the concrete. Laterals are of ½ in. galvanized pipe, and headers are of 1¼ in. black pipe. The laterals have steel channels clipped across them. Corner brackets of iron hold the panels and prevent any side sway. A 2 in. layer of glass fiber insulates the pipes on the upper side. The lower side is covered with 12×14 in. aluminum tiles. There are two main operating rooms thus treated, the fracture room, and another examination room in the same area.

Liberal insulation of piping for the hot water heating system, the steam lines, hot water supply lines and the location of these pipes away from the outside walls as far as possible is expected to be a factor in saving heat losses.

Steel tiles in the suspended ceilings of all corridors, and in many of the larger rooms, are expected to facilitate both maintenance and extensions of any of the piping systems.

Asphalt coating in exposed locations protects water and drain pipes.

The heating contractor was Mobec, Ltd. The ventilation contractor was J.A.Y. Bouchard, Inc. The architect was Lucien Mainguy. ‡

Calculating Pipe Stress Efficiently

This is the second in a series of articles presenting a working method designed to correctly and efficiently calculate piping stresses. The procedure, based on the 1955 American Standard Code for Pressure Piping, saves time and work. The most significant factors include:

1) The application of the flexibility factor *K* and the stress intensification factor *i* (applied to all three perpendicular planes, instead of only the plane of elbow).

2) The formulas and calculation of: the above factors *K* and *i*; characteristic factor *h*; allowable stress (stress range); maximum expansion stress; force and moment ranges; and hot and cold reactions.

3) The phenomenon of self springing.

BY K. HAO HSIAO
Consultant for Piping Stress Analysis

THE FIRST ARTICLE on this subject in the September HPAC discussed three dimensional piping systems and the calculation of line inertias. This article details the calculation of moments and torques, determination of signs, hot and cold forces and moments, pipe stresses, allowable limits, and centroidal moments and products of inertia of elbows and bends.

Calculation of Moments and Torques; Determination of Signs. The tabulation, computation, and determination of signs in Table 2 are entirely an "automatic" procedure. The values of forces (X,Y,Z), the coordinates of points on the system (x,y,z) and the centroidal coordinates of the system $(\bar{x},\bar{y},\bar{z})$ are first filled in Table 2. The relative moment values on rows 1, 2, 3, 4, 5, and 6 are calculated. Then the signs of these relative moments for the first point *a* on the system are determined as explained in the next paragraph. After that, the signs of moments for the remaining points are "automatically" and instantly determined from the first point. For instance, in Table 2 of Example 1, since the sign of the value on row 1 for point *a* is the same as that of $y - \bar{y}$, the signs of all remaining values on row 1 are the same as those of the coordinates above them. This is indicated by plus sign under heading "sign" in Table 2. Similarly, since the sign on row 2 for point *a* is opposite to that of $x - \bar{x}$, the signs of all the remaining values on row 2 are opposite to those of the coordinates above them. This is indicated by minus sign under the heading "sign." The same rule applies to rows 3, 4, 5, and 6. Thus, only the signs of moment values for point *a* need be determined. All the remaining signs in the entire Table 2 can be instantly filled in without thinking.

The signs of the relative values on rows 1 to 6 for point *a* are determined as follows. As shown in Fig. 1, the *X-Y* plane is parallel to paper, and the *Z* axis is perpendicular to paper. The analyst should view the *X-Y* plane by looking down at the paper, the *X-Z* plane from the top of paper, and the *Y-Z* plane from the right side of the paper. Then, open the right palm, and point the thumb in the direction of a force and the remaining fingers in the direction of centroidal distance of a point in the piping system (end or joint), i.e., the direction of coordinate $x-\bar{x}$, $y-\bar{y}$, or $z-\bar{z}$ in Table 2. If the palm is toward the analyst, the moment or torque is negative. If the back of the hand is toward the analyst, it is a positive value. For instance, in Table 2 of Example 1 for point *a* in *X-Y* plane, since the sign of $y-\bar{y}$ is negative $(-4.67$ ft), point right thumb in the direction of *X* force and the remaining fingers in the direction of negative *Y* axis. In this case, the palm of the right hand is toward the analyst, so the relative moment X' $(y-\bar{y})$ is a negative value (-7.66). This is indicated by plus sign under the heading "sign" in Table 2. Using the same rule, the relative moment Y' $(x-\bar{x})$ is also a negative value (-4.75). This is indicated by minus sign under the heading "sign". The total relative moment M'_{xy} at point *a* is the algebraic sum of the two values or -12.41. When the force is a negative value, indicating its direction opposite to that assumed originally, the analyst should point the thumb in the same negative direction. In this way, positive signs of M'_{xy}, M'_{xz}, and M'_{yz} indicate clockwise direction, while negative signs, counterclockwise direction. If the analyst requires only numerical values of bending moment and torque, and not their directions, then $M'_{xy} = (1)-(2)$, $M'_{xz} = (3)-(4)$, $M'_{yz} = (5)-(6)$, where the signs of (1), (2), (3), (4), (5)

and (6) agree with their respective coordinates. In this case, the column under heading "sign" may be ignored.

Although the positive direction of any one of the axes shown may be reversed due to reversal of direction of expansion along that axis, it is convenient for the analyst to use the same notations for the axes, i.e., X and Y for axes in a plane parallel to paper.

Of the three moment values, two are bending and one, torsional. The greatest vector sum of the former, multiplied by the force Z, gives the maximum combined bending moment of the system, and the latter, multiplied by Z, gives the corresponding torque. In this case, the maximum combined bending moment is, by inspection, at point d, i.e., 9640 ft-lb.

In Fig. 3, end a is assumed to be connected to a large diameter header at the same temperature and anchored 3 ft, 7 in. away from a in the direction of X axis. Therefore, the total length for expansion in the system in the X direction is 31.3 ft, and the expansion is $\triangle_x = 0.313(13.1) = 4.1$ in. The expansion in the Z direction is $\triangle_z = 0.20(13.1) = 2.62$ in.

Hot and Cold Forces and Moments. The forces X, Y, and Z and moments and torques from Tables 1 and 2 are "ranges," from which their values in hot and cold conditions can be obtained. For instance, the X force in hot and cold conditions are obtained from the following formulas per the 1955 Code for Pressure Piping:

$$\left.\begin{aligned} X_h &= [1 - (2/3)(C)]\,(E_h/E_c)X \\ X_c &= cX, \text{ or} \\ X_c &= [1 - (S_h/S_c)(E_c/E_h)]\,X \end{aligned}\right\} \quad \text{.....[18]}$$

where: $(S_hE_c)/(S_cE_h) < 1$

Assuming 50 percent cold spring or $c = 0.5$, we have:

$$X_h = (2/3)(21.6/27.4)\,919 = 484 \text{ lb}$$

$$X_c = [1 - (6600/25{,}150)(27.4/21.6)]\,919 = 613 \text{ lb}$$

Equation 18 applies also to moments and torques from Table 2, changing X to M or T.

Pipe Stresses. The expansion stress s_e at any point in a system, based on E_c and full expansion, is defined in the Code:

$$\left.\begin{aligned} S_e &= \sqrt{(S_b)^2 + 4(S_t)^2} \\ S_b &= (iM)/S \\ S_t &= T/2S \end{aligned}\right\} \quad \text{.....[19]}$$

where the stress intensification factor i is defined below for elbow, circular bend, and mitre bend, with the condition that it is greater than unity.

$$i = 0.9/h^{2/3} \quad \text{.....[20]}$$

The maximum value of s_e or the controlling stress range shall not exceed the allowable stress range s_a, defined in the Code:

$$S_a = f(1.25S_c + 0.25S_h) \quad \text{.....[21]}$$

For the effect of pressure and weight on expansion stress, the reader is referred to the Code. Assuming $f = 1$ and substantial pressure and weight stresses, we have, for the system in Fig. 3:

$$i = 0.9/(0.082)^{2/3} = 4.77$$
$$S_b = [4.77(9640)12]/22 = 25{,}100 \text{ psi}$$
$$S_t = [(1788)(12)]/[(2)(22)] = 488 \text{ psi}$$
$$S_e = \sqrt{25{,}100^2 + 4(488^2)} = 25{,}150 \text{ psi}$$
$$S_a = 1.25(18{,}750) + 0.25(6600) = 25{,}100 \text{ psi}$$

therefore, the system in Fig. 3 is not overstressed.

The procedure for computing force and moment ranges (Tables 1 and 2) and controlling stress range (Equation 19) on the basis of E_c and full expansion range is equivalent to computing the forces, moments, and stresses as if the line had been cold sprung 100 percent. These values represent the ranges or a conservative estimate of the sums of hot and cold forces, moments, and controlling stresses in the system. The exact values of these sums for different c factors are always greater than their respective ranges, thereby providing a margin of safety.

For instance, for the force X and 50 percent cold spring, this margin is:

$$X_h + X_c - X = (2/3)(21.6/27.4)X + [1 - (6600/25{,}150)(27.4/21.6)]\,X = 0.19X$$

The use of allowable stress range as the limit for controlling stress range, and the computation of maximum hot and cold forces and moments from their respective ranges, based on E_c and 100 percent expansion, are deduced from the phenomenon of "self springing," resembling cold springing. (The relaxation of initially high stresses in the hot condition and the creation of reversed stresses in the cold condition.) This phenomenon is explained by A. R. C. Markl in his excellent paper, "Piping Flexibility Analysis," Transactions of the American Society of Mechanical Engineers, Vol. 77, No. 2, February 1955.

Allowable Limits. Assuming that end k of the system in Fig. 3 is at the nozzle of an equipment, the numerical values of hot and cold forces, moments and torques at k

$X' = X/Z = 1.64$		POINT	a	b	c	d	e	f	g	h	k
$Y = Y/Z = .254$		COORD. X	27.7	27.7	26.2	1.5	0	0	0	0	-1.5
$Z' = 1$		Y	0	6.4	7.9	7.9	6.4	1.5	0	0	0
		Z	0	0	0	0	0	0	-1.5	-18.5	-20
X	FOR SIGN	$\bar{X} = 8.97$	$X - \bar{X}$	18.73	18.73	17.23	-7.47	-8.97	-8.97	-8.97	-8.97	-10.47
		$\bar{Y} = 4.67$	$Y - \bar{Y}$	-4.67	1.73	3.23	3.23	1.73	-3.17	-4.67	-4.67	-4.67
	(1)	+	$X(Y-\bar{Y})$	-7.66	2.84	5.30	5.30	2.84	-5.20	-7.66	-7.66	-7.66
	(2)	−	$Y(X-\bar{X})$	-4.75	-4.75	-4.38	1.9	2.28	2.28	1.38	2.28	2.66
	(1)+(2)		M_{XY}	-2.91	-1.91	0.92	7.2	5.12	-2.92	-6.28	-5.38	-5.00
N		$\bar{Z} = -6.2$	$Z - \bar{Z}$	6.2	6.2	6.2	6.2	6.2	6.2	4.7	+2.3	-13.8
X	(3)	−	$X(Z-\bar{Z})$	-10.2	-10.2	-10.2	-10.2	-10.2	-10.2	-7.71	20.2	22.6
	(4)	+	$\bar{Y} = 6.92$	$Z(X-\bar{X})$	20.78	20.78	19.28	-5.92	-6.92	-6.92	-6.92	-6.92	-8.42
	(3)+(4)		M_{XZ}	10.58	10.58	9.08	15.62	17.12	17.12	14.63	13.28	14.18
		$\bar{Z} = -3.73$	$Z - \bar{Z}$	3.73	3.73	3.73	3.73	3.73	3.73	2.23	-4.77	-16.27
N	(5)	−	$Y(Z-\bar{Z})$	-.95	-.95	-.95	-.95	-.95	-.95	-.57	3.26	4.13
Y	(6)	+	$\bar{Y} = 3.76$	$Z(Y-\bar{Y})$	-3.76	2.64	4.14	4.14	2.64	-2.26	-3.76	-3.76	-3.76
	(5)+(6)		M_{YZ}	-4.71	1.69	3.19	3.19	1.69	-3.21	-4.33	-.01	0.37

MAX. MOMENT @ "d"

$M'_d = \sqrt{7.2^2 + 15.62^2} = 17.2$ $\quad M_d = 560(17.2) = 9640$ ft-lb

$T'_d = 3.19$ $\quad T_d = 560(3.19) = 1788$ ft-lb

AT "k"

$M_k = 560\sqrt{5^2 + 14.18^2} = 8900$ ft-lb. $\quad T_k = 560(0.37) = 207$ ft-lb.

TABLE 2—MOMENTS AND TORQUES as shown here are tabulated, computed, and their signs determined "automatically" by following the procedure outlined in the text

must be kept below allowable values, in order to avoid distortion of the equipment. Expressed in symbols, these values are X_h, X_c, Y_h, Y_c, Z_h, and Z_c obtained from X, Y, and Z of Table 1, and $(M_h)_k$, $(M_c)_k$, $(T_h)_k$, and $(T_c)_k$, obtained from M_k and T_k of Table 2, all by means of equations similar to Equation 18. Two sets of approximate allowable values have been suggested by Rossheim-Markl and Wolosewick "in the absence of suitable manufacturer's data or applicable experience".* Pumps and turbines are especially sensitive to thrusts and distorting moments exerted by attached piping, so special care must be exercised in limiting the magnitudes of these reactions.

The maximum combined bending moment M_d in the system should also be kept within allowable limits, in order to prevent leakage at valves, flanges, and other joints. An alternative is to place these joints at points of low moment.

In addition to the above requirements, the piping engineer must see to it that the piping material is not overstressed beyond its allowable range at any point of the system. This is accomplished by keeping the value of s_c below s_a, as explained in the previous section.

To fulfill the above design requirements, the piping system must possess sufficient flexibility to minimize the detrimental effects of thermal expansion, especially for large diameter high alloy piping at high temperatures.

*D. B. Rossheim and A. R. C. Markl, "The Significance of, and Suggested Limits for, the Stress in Pipe Lines Due to the Combined Effects of Pressure and Expansion," ASME Transactions, Vol. 62, 1940, pp. 445-460.
F. E. Wolosewick, "Equipment Stresses Imposed by Piping," Petroleum Refiner, August 1950, pp. 89-91.

Nomenclature

L = length of each piping branch, ft
x, y, z = coordinates of the centroid of each piping branch or elbow with respect to the original arbitrarily chosen X, Y, and Z axes, ft
$\bar{x}, \bar{y}, \bar{z}$ = coordinates of the centroid of piping system with respect to the original arbitrarily chosen X, Y, and Z axes, ft
I_x, I_y, I_z = moments of inertia of the system about its centroidal axes, ft³ (magnified 12 times)
I_{xy}, I_{xz}, I_{yz} = products of inertia of the system about its centroidal axes, ft³
I_1 = centroidal moment of inertia of branches parallel to Z axis, ft³ (magnified 12 times)
I_2 = centroidal moment of inertia of branches parallel to Y axis, ft²
I_3 = centroidal moment of inertia of branches parallel to X axis, ft³
I_{ox}, I_{oy}, I_{oz} = sums of centroidal moments of inertia of elbows about their own respective neutral axes, ft³
m = number of elbows in planes parallel to the axis of I_o
n = number of elbows in planes perpendicular to the axis of I_o
$I_{oxy}, I_{oxz}, I_{oyz}$ = sums of centroidal products of inertia of elbows parallel to the plane of inertia, ft³
$\Delta x, \Delta y, \Delta z$ = total thermal expansion of the system in the X, Y, and Z directions respectively, in.
E_h = modulus of elasticity of the piping material at operating temperature or in the hot condition, psi
E_c = modulus of elasticity at installation temperature or in the cold condition, psi
I = moment of inertia of the cross-sectional metal area of the pipe, in⁴.
S = section modulus of pipe, in³.
D = outside diameter of pipe, in.
t = thickness of pipe wall, in.
r = mean radius of pipe, in.
T = temperature, F
e = thermal expansion in 100 ft of pipe due to a rise from installation temperature to operating temperature, in. per 100 ft
R = radius of curvature of elbow or quarter bend, ft
X, Y, Z = forces due to expansion, lb
M_{xy}, M_{xz}, M_{yz} = bending moments due to X, Y, and Z forces in XY, XZ, and YZ planes (one of these moments is actually a torque) ft-lb
X', Y', Z' = relative force values
$M'_{xy}, M'_{xz}, M'_{yz}$ = relative moment values in XY, XZ, and YZ planes
M'_d, M_d = relative and absolute values of combined bending moment at point d of the system, ft-lb
T'_d, T_d = relative and absolute values of torque at point d, ft-lb
h = characteristic factor
K = flexibility factor
L_a = actual length of elbow or quarter bend, or effective length of mitre bend, ft
i = stress intensification factor
α = transverse virtual length, ft
β = differential virtual length, ft
θ = one-half angle between adjacent mitre axes, degrees
c = cold spring factor
X_h, X_c = values of X force in hot and cold conditions, lb
s_b = maximum bending stress, psi
s_t = corresponding torsional stress, psi
s_a = allowable stress range, psi.
f = stress range reduction factor. ($f = 1$ for 7000 or less temperature cycles over expected life of piping.)
(1) to (27) = numerals each representing one row of figures
A, B, C = symbols each representing one numerical value
(a), (b), (c) = symbols each representing three values, A, B, and C
N = total number of elbows in a system
N_{xy} = number of elbows parallel to XY plane

Centroidal Moments and Products of Inertia of Elbows and Bends. Applying the factors K and $(K + 1)/2$ to the formulas for centroidal line inertias of elbows in Spielvogel's book, we obtain the following values for the elbow in Fig. 2:

$$\left.\begin{array}{l} XY \text{ plane} \\ \quad I_{ox} = 0.149KR^3 \\ \quad I_{oy} = 0.149KR^3 \\ \quad I_{oxy} = 0.137KR^3 \\ XZ \text{ and } YZ \text{ planes} \\ \quad I_{oz} = 0.149\,[(K + 1)/2]\,R^3 \end{array}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots [22]$$

It is evident from Equation 22 that for any circular 90 deg elbow, each of the centroidal moments of inertia about its own centroidal axes in its own plane is $0.149KR^3$, and the total centroidal moment of inertia about the third axis perpendicular to its own plane is $0.149(K + 1)R^3$. The centroidal product of inertia in its own plane is $0.137KR^3$. Therefore, the summarized expressions for centroidal line inertia values for the entire system, when there are more than one elbow having the same radius of curvature R, are:

$$\left.\begin{array}{l} I_{ox} = I_{oy} = I_{oz} = 0.149R^3\,[Km + (K + 1)n] \\ \qquad\qquad = 0.149R^3\,[KN + n] \\ I_{oxy} = I_{oxz} = I_{oyz} = 0.137KR^3\,\Sigma \pm \text{ signs} \end{array}\right\} \quad \ldots\ldots [23]$$

The selection of sign for Equation 23 depends upon the positive directions of centroidal axes of each elbow parallel to plane of line inertia, the same as the positive directions of axes of piping system. When only the positive direction of one centroidal axis cuts through the elbow circle, the term $0.137KR^3$ is a positive value; otherwise, it is a negative value. Therefore, the second equation in Equation 23 is the algebraic sum of all $\pm$ $0.137KR^3$ values for elbows parallel to plane of XY, XZ, or YZ (for I_{oxy}, I_{oxz}, or I_{oyz}, respectively) i.e., $\Sigma \pm$ signs is the algebraic sum of all the positive and negative signs of products of inertia for elbows parallel to plane of XY, XZ, or YZ. Take, for instance, the elbow in XY plane, in Fig. 2. Since, in this case, the positive direction of only one centroidal axis of the elbow in XY plane cuts through the elbow circle, we use $+ 0.137KR^3$. When the numbers of positive and negative signs are equal, the sum of products of inertia for that plane equals zero. In this case, it is not necessary to calculate, regardless of the total number of elbows in that plane.

Applying Equation 23 to the system in Fig. 3, we have:

$$I_{ox} = I_{oy} = 0.149(1.5)^3\,[20.1(4) + 1] = 40.9 \text{ ft}^3$$
$$I_{oz} = 0.149(1.5)^3\,[20.1(4) + 2] = 41.4 \text{ ft}^3$$
$$I_{oxy} = 0$$
$$I_{oxz} = I_{oyz} = 0.137(20.1)1.5^3 = 9.3 \text{ ft}^3$$

Since the above values are negligible in comparison with the total line inertias in Table 1, they are not included in Table 1. However, when the radius of curvature R is large, or when distances between elbows are small, it may be necessary to calculate the summarized centroidal line inertias and add them to total line inertias in Table 1.

Selfchecking Way of Locating Centroids in Table 1. In piping stress calculations, the tabulation of correct x, y, and z coordinates for each branch and each elbow of the system is of the utmost importance. The accuracy of the coordinates can be assured as soon as their numerical values are tabulated by the following "selfchecking way." For instance, for the system in Fig. 3, starting from end a, the location of the centroid of each branch or elbow is calculated as below:

x	y	z
27.70 *ab*	5.20 *ab*	.0 *ab, bc, cd, de, ef*
0.54	5.20	− 0.54 *fg*
27.16 *bc*	0.96	− 0.54
0.96	7.36 *bc*	− 0.96
26.20	0.54	− 8.50
12.35	7.90 *cd* (check)	−10.00 *gh*
13.85 *cd*	0.54	− 8.50
12.35	7.36 *de*	− 0.96
1.50	0.96	−19.46 *hk*
0.96	6.40	− 0.54
0.54 *de*	2.45	−20.00 (check)
0.54	5.95 *ef*	
0 *ef, fg, gh* (check)	2.45	
0.54	1.50 (check)	
−0.54 *hk* (check)	0.96	
	0.54 *fg*	
	0.54	
	0 *gh, hk* (check)	

This selfchecking way of locating centroids can also be applied in Table 2 for the tabulation of x, y, and z coordinates for points a to l inclusive.

Advantages of This Procedure. In addition to saving time and labor, without sacrificing accuracy, there are the following advantages for the procedure presented here:

1) The proportion of simplification increases with the number of branches and elbows. Increase in branches only increases the numerical values under headings "branches" and "elbows" and does not affect the remaining portion of Table 1. Thus, if the number of branches and elbows is increased from seven to 14, the only change in Table 1 is the tabulation of seven additional rows of numerical values.

2) It is not necessary to locate in three perpendicular planes (in addition to an isometric view): (a) the true centroidal axes of the piping system, (b) the coordinates with respect to these axes of individual centroids of different piping branches and elbows (for calculation of line inertia values), and (c) the coordinates of ends and joints between the piping branches (for calculation of moments and torques). The analyst requires only a simple isometric view, where such locations are unnecessary.

3) It is not necessary to carry out computations for line inertias in three different tables for three perpendicular planes. Only one table, i.e., Table 1, suffices.

4) The procedure in Table 2 reduces the work of determining signs for moments and torques at all points in a system to that at only one point.

All the above advantages reduce chances for errors. ∓

In the next article to be published in an early issue the author will continue to discuss the factors leading to efficient calculation of pipe stress.

To provide clean air at controlled temperatures and humidity conditions for textile processes and employee comfort . . .

Central Plants Condition Three Mills

Centrifugal compressors installed in one existing and two new plants

CENTRAL air conditioning systems were recently installed in three North Carolina textile mills for process requirements and employee comfort, according to Trane Co.

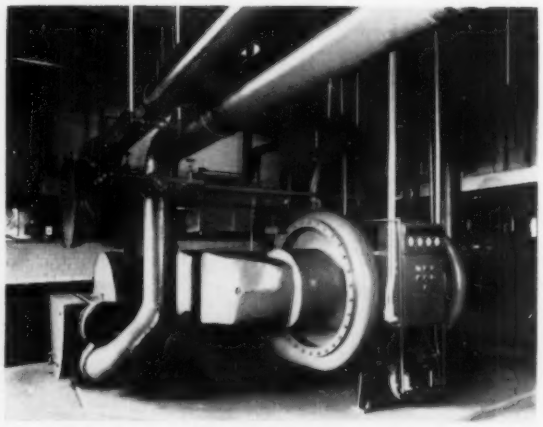
At the existing mill of the Highland Park Manufacturing Co., Charlotte, shown here, 322 tons of air conditioning capacity was installed for a central station refrigeration and air cleaning system. No matter how carefully the yarn was spun, it was difficult before to keep it clean. For years soot and smoke laden air lowered the quality in the carding and spinning departments of the mill, located in a highly industrialized area. During hot summer months employee absenteeism was above normal. In winter, yarn, machinery, floor, and walls were subjected to carbon and tar deposits carried into the building by dirty outside air.

From a water chiller in the basement, 1000 gpm of water at 46.6 F is circulated through insulated supply and return piping to air washers in the carding and spinning departments.

Water supply to the chiller comes from a redwood induced draft cooling tower. The tower provides 963 gpm of water, cooling it from 95 F to 85 F when the outside air wet bulb temperature is 78 F.

A centrifugal fan with a maximum air volume capacity of 18,200 cfm supplies the card room with 13,800 cfm of air. For the spinning room, 60,000 cfm of air is supplied from the system which is capable of a maximum air delivery of 90,000 cfm.

Temperature the year 'round is kept at 80 F dry bulb and 50 percent relative humidity when the outside temperature is 90 F DB, 78 F WB. This keeps the hundreds of mill employees comfortable and on the job during hot spells, while the filtered, washed air is providing lower maintenance costs, improved yarn quality, and fewer seconds.



Another mill, the new Acme Hosiery Mill in Asheboro — one of the few in the country designed exclusively for the production of women's seamless hosiery — uses 200 tons of air conditioning capacity for process and comfort.

The one story brick and steel building includes 55,000 sq ft of floor area. It contains 1000 knitting machines and 250 loopers designed to produce 20,000 dozen pairs of hose each week.

Chilled water is supplied by a 200 ton capacity centrifugal compressor. Separate fan units with individual controls provide the varying amounts of air needed in the knitting and looping areas.

Conditioned air is fed directly to the knitting machines. As a result, constant humidity and temperature levels are achieved, increasing machine efficiency and improving hose quality.

Ideal conditions in hosiery mills seem to be 82 F DB and 50 percent RH. These are the conditions maintained by the 100 ton chilled water system recently installed at a third North Carolina plant, the Wisteria Hosiery Mills in Gastonia. The system automatically washes and humidifies the air, and heats or cools it. ⧺

Tear out along this line

HPAC DATA SHEET

How to Find Equivalent Lengths of Elbows in Rectangular Ducts

BY JULIAN T. EUBANKS
Associate Engineer
Patchen & Zimmerman, Engineers

THE CHART on the next page provides a short cut to finding equivalent lengths of elbows in rectangular ducts of air conditioning and ventilating systems. It gives a length directly in feet when the dimension of the duct in inches and the radius ratio of the duct are known.

Examination of the chart will show that it is composed of three sections arranged to be used in conjunction with each other.

The lower right section is the solution of the ratio, H/W.

The upper right section is the solution of the equation, $L/W = [0.33\ (R/W)]^{-2.13\ (H/W)\ 0.126}$.

The upper left is the solution of the ratio $[(L/W)W]/12$.

The isometric sketch of the elbow at the lower left shows the relationship of dimensions H, W, and R. R is always the center line radius. W is always measured radially, while H is measured axially.

How to Use Chart

Enter the chart at the left side of the lower right section with the height of the duct, H. Proceed horizontally to the right to the diagonal line representing the width of the duct, W, then vertically upward to the upper right section to the diagonal line of radius ratio, R/W.

At this point, turn left and go horizontally to the diagonal line in the left section indicating the width, W, of the duct. Drop vertically to the bottom of the left section, at which point will be found the equivalent length of the elbow in feet.

Sample Problem

Find the equivalent length of an elbow in a duct 42 in. wide × 15 in. high, with a center line radius of 63 in.

Use of the formula, R/W,—or 63 in. center line radius/42 in. duct width—indicates a radius ratio of 1.5.

Enter the chart at $H=15$ in. Move across to the right to the diagonal line, $W=42$ in., then vertically to the diagonal line, $R/W = 1.5$. Turn horizontally left to $W = 42$ in., and down to the bottom of the left section of the chart.

This point of intersection shows the equivalent length of elbow to be 13 ft. ⫩

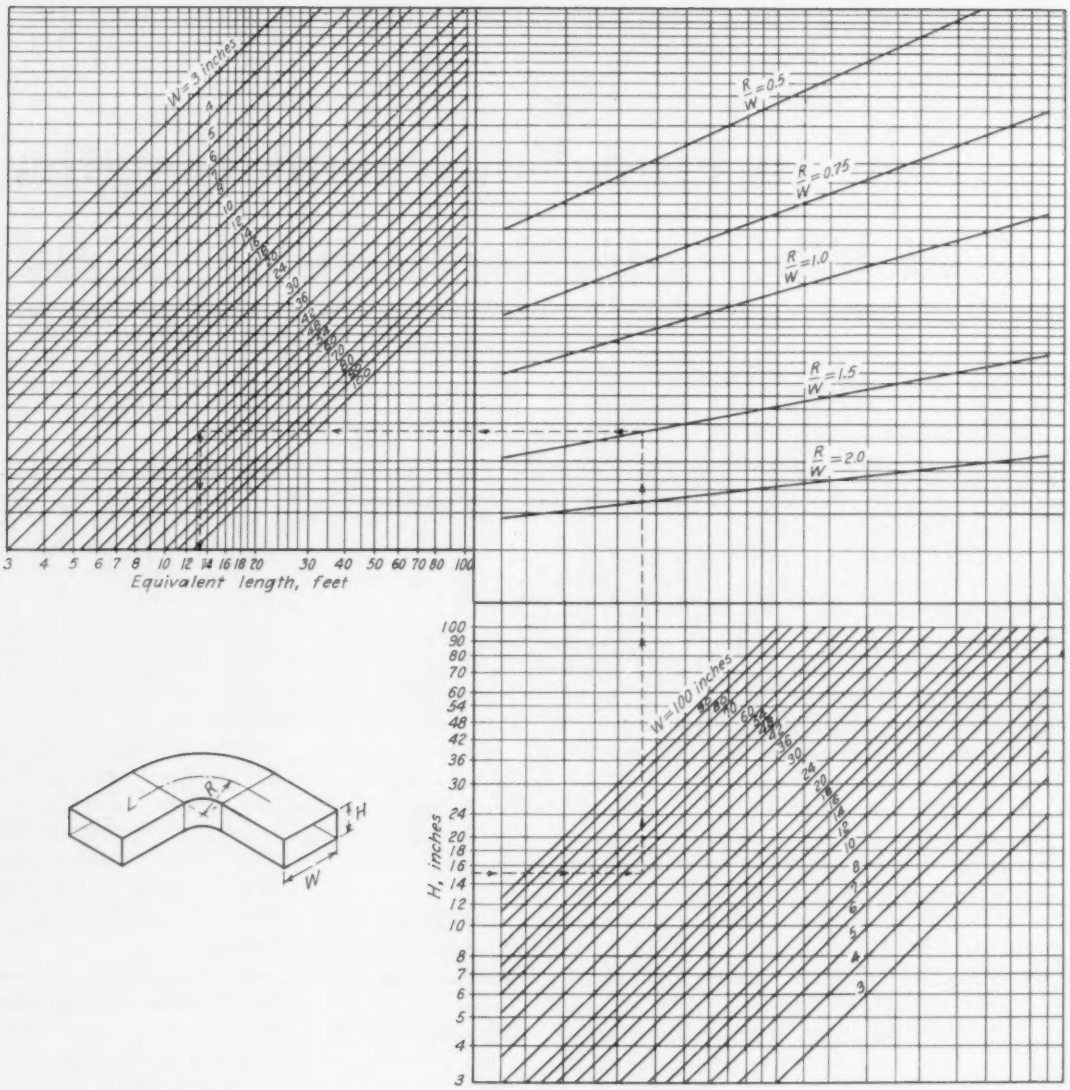


CHART provides short cut to finding equivalent lengths of elbows in rectangular ducts. How to use it is described on preceding page

The object of the Society is to advance the arts and sciences of heating, ventilating, cooling and air conditioning, and the allied arts and sciences, for the benefit of the general public, to encourage and conduct scientific research, and to cooperate with other organizations having the same or similar objectives.

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SOCIETY COMMITTEE ORGANIZATION

General Committees: The By-Laws provide for 9 such committees. The latest list appears in the August 1957 issue on page 156

Research Committees: The research program is under the guidance of the Committee on Research — a General Committee. The Committee on Research appoints Technical Advisory Committees as needed. The listing appears in this issue on page 160

Special Committees: At present there are 9 of these committees. The latest list of them and of their personnel can be found in the August 1957 issue on page 156

Nominating Committee: This committee's membership is fixed by the By-Laws. The latest listing appears in the August 1957 issue on page 156

SOCIETY REGIONAL ORGANIZATION

The latest listing of the names of the Regional Directors and of the members of the Chapters Regional Committees appears in the November issue on page 202

SOCIETY CHAPTERS AND BRANCHES

The Society has chartered 69 Chapters, 1 Overseas Branch, and 6 Student Branches. These groups elect their officers and governing boards. A list of the presidents and secretaries appears in the October 1957 issue on pages 165-166

The President's Page

Honors and Awards

I want to take advantage of this opportunity to acquaint you with the present status of the Society's program on HONORS and AWARDS. Often, questions develop because of a lack of understanding by the members of the Society's policy in these matters.

For many years, the important Society award has been the *F. Paul Anderson Medal.* This is bestowed annually, in accord with the terms of the presentation letter of Thornton Lewis, on a Society member whose past contributions and accomplishments in our field have been outstanding. The past recipients are an imposing listing of those very men whose work and writings have been so important in the technical advances and progress of our profession.

There have been several steps taken in recent years towards granting more Society honors, not only at the national level, but also by chapters and by certain regional groups. The Council recognizes the wisdom and importance of these moves. It believes that one of the more important responsibilities of any technical or professional society is honoring those who have made significant contributions toward the advances upon which the prestige and usefulness of the profession depend.

For this reason, the Society now confers the honorary grade of FELLOW on several Members each year in recognition of their outstanding achievements in their professional work as engineers. Another award of recent years is the *ASHAE-Homer Addams Award* to a graduate student majoring in HVAC work at a school or college that has a cooperative research agreement with the Society.

The current Council policy in this area of Society activity results from a report prepared in January 1956 by an exploratory committee on Honors and Awards. This committee (Messrs. Linn Helander, M. F. Blankin and G. L. Tuve) was appointed to study what policy the Society should adopt and what actions it should take with respect to honors and awards. In brief, the highlights of this report are:

All Society matters regarding honors and awards shall be administered for Council by a Committee on Honors and Awards.

This committee shall accept grants for the establishment of new awards.

All proposals for awards or other recognition shall be passed on by the Honors and Awards Committee before action by Council.

In accord with the recommendation of the exploratory committee, the Council has established a three-man Committee on Honors and Awards. Ultimately, a By-Laws revision will be made to consolidate the work of this committee with that of the F. Paul Anderson Award Committee. For the time being, the new Committee on Honors and Awards is responsible to the Council for all actions, policy, recommendations and activity in the area of honors and awards — not only at the national level, but also at the regional and at the chapter level. This centralized control and advice are important and necessary to insure for the Society as a whole that:

Awards adequately contribute to the prestige of the recipient and to the Society.

Awards serve as a stimulant to a high level of accomplishment.

Awards be relatively few in number and highly regarded.

Awards are not established for the principal purpose of advancing the prestige of a group or organization.

P. B. Gordon

President
AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS

Sun Energy Assistance for Air-Type Heat Pumps†

By Chester P. Davis, Jr.* and Ralph I. Lipper**, Manhattan, Kans.

THE AIR-TYPE heat pump has become the major type of heat-pump unit manufactured. These units, using air as a heat source, are influenced more than other types by the extremes, the severity, and the variability of outdoor air temperature and relative humidity. Low outdoor temperature decreases heating capacity and coefficient of performance (CP) during the period when the greatest demand for heat is required. Stated another way, the heat loss of the conditioned space is usually maximum when the heat source for the heat pump is the poorest from a thermodynamic viewpoint. Defrosting problems of the outdoor coil may be serious during high humidity periods when outdoor air temperatures are 28 to 38 F.

These limitations have delayed and limited acceptance of this type of year-round air-conditioning equipment in northerly areas where more severe winter climatic conditions are encountered. The decreased efficiency and capacity in these areas may require appreciable quantities of supplemental electrical resistance heat. Extensive usage of these heaters results in poorer demand and load factors than is experienced with this equipment in milder climates. These factors offer less incentive to the electric utility to provide a more favorable electric rate structure for home heating with the heat pump.

Limited studies[1] indicate that the availability of solar radiation is above average during periods of extremely cold weather. The principal exceptions are in the vicinity of the Great Lakes and other large bodies of water.

SUMMARY — Acceptance of the air-type heat pump as a means of year-round air conditioning is delayed and limited by its decreased capacity when maximum capacity is required. A means of supplementing the capacity is the use of solar energy. This study does not cover the direct use of solar energy for the purpose but rather is concerned with using a heat storage with a simple low-cost flat-plate collector to capture the sun's energy. This heat is then made available for home heating via the heat pump cycle. Such a collector is described and illustrated. The study was conducted making use of 2 comparable independent systems with one arranged to accommodate this collector and storage.

A collector and suitable storage means can be accomplished with minimum system addition and change. Reduction and simplification of the coil defrost problem is demonstrated. This type of supplementation of heat pump capacity offers enough advantage to warrant continued development. The paper is thus a progress report on a continuing project.

It was with these factors in mind that heat pump research attention at Kansas State College was turned to utilization of sun energy as a logical supplement to an air-source heat pump system in late 1953 and 1954. At that time, a considerable quantity of basic information for system design had become available from theoretical studies at the University of Minnesota.

Plan for Utilizing Solar Energy

After a search of the literature pertaining to solar collection and with several practical considerations in mind, it was decided to study a simple low-cost flat-plate type collector for air heating. The collector visualized could serve a structural purpose in most applications. Air drawn through the collector would be the heat source for a heat pump. This air would be warmed during periods of solar radiation. It was anticipated that solar radiation received in excess of need during daytime hours might be stored for nighttime use.

By collecting and storing solar energy at low temperatures for delivery to the heated space via the heat pump cycle, losses from a simple collector and low-cost storage would be minimized. Direct use of solar energy for space heating was not contemplated in this study. However, such a low-cost collector appears to possess potential value for air warming either with or without the heat pump in certain agricultural applications. Many farm structures use the type of construction basically represented by this collector. Moderately heated air could be useful for grain drying or for animal-shelter ventilation.

Collector Design

An adaptation was made of a typical insulated wall or roof surface covered with corrugated sheet metal painted black. This metal was fastened over sheathing nailed to studding or rafters. A 5-mil thick biaxially oriented plastic film (acrylonitrile-styrene copolymer) was framed and placed with an intervening air space over the sheet metal. Function of the film was to pass solar radiation but trap long-wave re-radiation from the

†This paper was approved as *Scientific Journal Article No.* 81, Kansas Agricultural Experiment Station.

*Research Engineer, Farm Electrification Laboratory, Agricultural Engineering Research Division, Agricultural Research Service, U.S. Department of Agriculture, in cooperation with the Kansas Committee on the Relation of Electricity to Agriculture and the Kansas State College Agricultural Experiment Station.

**Associate Professor, Agricultural Engineering Department, Kansas State College.

[1]Exponent numerals refer to References.

For presentation at the 64th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, Pittsburgh, Pa., January 1958.

blackened plate. It was found desirable to limit deflection and billowing of the plastic by placing it in a sandwich of wire netting. This prevented the film from contacting the collector surface and conducting away significant quantities of absorbed heat. The air channel above the plate combined with the channel formed between the sheet metal and sheathing provided heat exchange from both surfaces of the sheet-metal absorber to the air forced through the collector. The corrugations were believed to increase that heat exchange, provide a larger area for absorption of solar energy and perhaps reduce reflection over that of a flat-plate surface. No attempt has been made to confirm how significant this geometry is in terms of increased gain in heat collection.

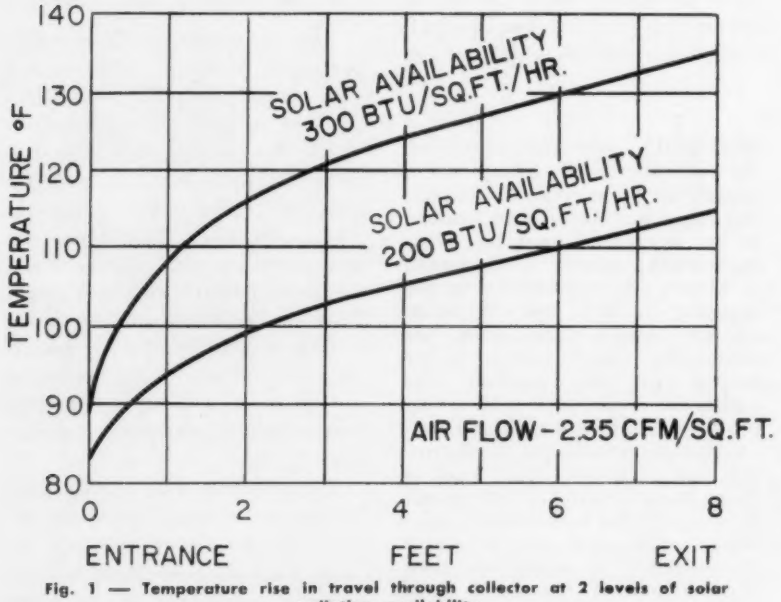

Fig. 1 — Temperature rise in travel through collector at 2 levels of solar radiation availability

Heat transfer due to the log-mean temperature difference between the collector plate and air passing through it was known to be greater for shorter travel distance through the collector. Using temperatures of collector-heated air, this is shown for 2 radiation levels in Fig. 1. Since these data were taken in late May, the final temperature of the air was considerably higher than realized during winter operation though the temperature rise from the inlet condition was comparable. On the basis of this information, it was found desirable to introduce air from both ends of the collector and exhaust it from a plenum located at the center of the collector panel.

Several plastic films of the polyethylene and vinyl type were studied but exposure over a period of a few months brought progressive deterioration, reduced solar transmission and ultimate failure. This was due to ultraviolet attack on the plasticizers used in formulation.

As in other solar research there was some question as to the respective merits of different orientations of the collector surface. After consultation with architects and study of the significance of departure from optimum it was initially decided that vertical orientation would be used for these studies. The considerations influencing this decision were that the collector could be satisfactorily integrated as a portion of the house wall structure, an extension of that surface, or a yard screen. Other practical considerations are ease of repair, reduction of hail damage, and adaptability to shading. Shade from an overhanging roof or shielding

Table 1 — Heating requirements of a hypothetical house using a heat pump over the range of −7.5 to 62.5 F outside temperature and with 10 and 20 deg average rise through solar collector and/or storage

Outside Air Temperature	Air Temp. From Collector and Storage		CP			Heat Pump Capacity (Thousand Btu)			Required Capacity (Thousand Btu)	Electrical Heater Capacity			Heater Kwhr Required			Heat Pump Kwhr Required			Fan Kwhr	Total Kwhr		
T^a	10° Rise	20° Rise	αT	10° Rise	20° Rise	αT	10° Rise	20° Rise	Outside Temp	αT	10° Rise	20° Rise	αT	10° Rise	20° Rise	αT	10 Rise	20° Rise		αT	10° Rise	20° Rise
−7.5	2.5	12.5	1.32	1.58	1.82	21.5	28.0	34.6	67.0	45.5	39.0	32.4	13.33	11.4	9.5	4.78	5.2	5.58	0.28	18.11	16.88	15.36
−2.5	7.5	17.5	1.45	1.72	1.92	25.0	31.3	38.0	62.3	37.3	31.0	24.3	10.9	9.1	7.1	5.05	5.35	5.8	0.28	15.95	14.75	13.18
2.5	12.5	22.5	1.58	1.82	2.00	28.0	34.6	41.0	57.7	29.7	23.1	16.7	8.7	6.77	4.9	5.2	5.58	6.0	0.28	13.9	12.63	11.18
7.5[b]	17.5	27.5	1.72	1.92	2.08	31.3	38.0	44.5	53.0	21.7	15.0	8.5	6.35	4.4	2.5	5.33	5.8	6.3	0.28	11.68	10.48	9.08
12.5	22.5	32.5	1.82	2.00	2.18	34.6	41.0	47.5	48.5	13.9	7.5	11.0	4.07	2.2	3.2	5.57	6.0	5.05	0.28	9.64	8.48	8.53
17.5	27.5	37.5	1.92	2.08	2.32	38.0	44.0	40.5	44.0	6.0	0	3.5	1.76	0	1.02	5.8	6.2	5.1	0.28	7.56	6.48	6.4
22.5	32.5	42.5	2.00	2.18	2.46	39.3	37.5	39.3	39.3	0	1.8	0	0	0.5	0	5.75	5.05	4.7	0.28	5.75	5.38	4.98
27.5	37.5	47.5	2.08	2.32	2.57	34.8	34.8	34.8	34.8		0			0		4.9	4.4	4.0	0.28	4.9	4.68	4.28
32.5	42.5	52.5	2.18	2.46	2.68	30.0	30.0	30.0	30.0							4.03	3.58	3.28	0.28	4.03	3.96	3.56
37.5	47.5	57.5	2.32	2.57	2.82	25.5	25.5	25.5	25.5							3.22	2.91	2.76	0.28	3.22	3.19	3.04
42.5	52.5	62.5	2.46	2.68	2.95	21.6	21.0	21.0	21.0							2.5	2.3	2.09	0.28	2.5	2.58	2.37
47.5	57.5	67.5	2.57	2.82	3.12	16.5	16.5	16.5	16.5							1.88	1.72	1.55	0.28	1.88	2.00	1.83
52.5	62.5	72.5	2.68	2.95	3.26	11.8	11.8	11.8	11.8							1.29	1.17	1.06	0.28	1.29	1.45	1.34
57.5	67.5	77.5	2.82	3.12	3.45	7.2	7.2	7.2	7.2							0.75	0.68	0.61	0.28	0.75	0.96	0.89
62.5	72.5	82.5	2.95	3.26	3.60	2.5	2.5	2.5	2.5							0.25	2.2	0.2	0.28	0.25	0.50	0.48

[a]Temperature in Fahrenheit degrees. [b]See Appendix for sample calculation.

panels would reduce the absorption of summer solar-heat load. The chief advantage to an optimum inclined orientation is the absorption of a larger proportion of available solar radiation. For the period of maximum need for supplemental heat (November 1 to March 1), the reduced collection of solar radiation by using a vertical over an optimumly oriented surface is of the order of magnitude of 5-15 percent. Average reduction is less than 10 percent for the latitudes under consideration.

An area of 160 sq ft of this type collector surface was provided (Fig. 2) for the scale model system (approximately one-fifth) for laboratory-type tests.

Preliminary operational data on the collector alone showed collector plate temperatures of 140 to 145 F at noon on bright winter days with outside temperatures at 40 to 45 F. It was predicted from available radiation and this temperature difference[2] that the maximum collector efficiency would approach 45 percent. Data taken over a period of several days indicated actual average efficiency between 30 and 35 percent.

Laboratory Heat-Pump Systems

Two scale-model (¾ hp) independent systems were devised. One used outside air alone; the other used air after it passed through the collector (Fig. 3). Air could be diverted from one system to the other at any time to determine the extent of variance in system equipment performance. An initial series of tests was conducted using the collector and heat pump systems without heat storage.

Storage

During the peak portion of the solar day it was frequently noted that an excess of heat was collected in relation to that which could be used efficiently by the heat pump during those hours. As a result, air was discharged from the evaporator of the solar supplemented system at temperatures exceeding that of the outside air. This proved the need for storage to act as a *flywheel* or reservoir.

The concept adopted for storage requirements is that the collector and storage are supplemental, allowing considerable design freedom. Air is the primary source and can be supplemented in addition by electrical resistance heaters. However, since the objective of using solar energy is to minimize the demand of these heaters and maintain satisfactory capacity and performance factors for the air-type heat pump, broad design limitations are imposed.

Fig. 2 — Plastic-covered vertical, south facing, plate-type solar collector using air-heat exchange

No attempt was made to provide storage capacity equal to the total heating required. It was designed to provide a 20 deg temperature rise for 24 hr to the air supply for heat pumps of current design. Heat transfer rates to and from storage were important considerations.

The *low side* (evaporator) storage designed and studied consisted of water placed in plastic-film-sealed tin cans 4½ in. in diameter and 7 in. high. Heat was stored or released in latent (at 32 F) and sensible form by the air en route to the heat pump. Cans were placed in overlapping rows in the storage bin so that the air made effective contact to provide heat transfer from or to the water. It was found necessary to incorporate an expandable, anti-freeze-filled sleeve along the central axis within the cans and extending above the water surface to prevent can rupture. When the water froze, the anti-freeze solution pushed out and expanded in the container above the ice surface.

It was noted that some material which changes state at 45 to 55 F would be more satisfactory. Of several compounds used thus far, 1.2 dibromoethane has been the most satisfactory except for cost. To date, completely satisfactory, stable, and suitable compounds have not been found. Other studies in this field have sought a material primarily intended for use at a higher temperature level and for a basically different application.

Instrumentation

Instrumentation was provided to measure refrigerant flow, pressures, and temperatures for state-condition determination. Provision was made for measurements of water flow and temperature change through the water-cooled condenser, for air flow,

and for determining temperature outdoors, after the collector, at various points in the heat storage, and before and after the heat exchangers. Solar radiation and all other measurements except air flow were made with recording type instruments to provide a record for system analysis.

Method of Analysis of the Value of Solar Collection Combined with Air-Source Heat Pump

Prior to initiation of the past year's research, a study of the heating requirement for a hypothetical house was made using performance (Fig. 4) curves of a commercially produced air-type heat pump. A rational approach was thus sought to the analysis of the energy economy that might be realized through solar energy supplementation of that air source. An air flow of 1.5 to 3.0 cfm per sq ft as mathematically developed and confirmed by studies at the Michigan State University[3] was chosen as desirable.

With air temperature increases that could be practically realized, Table 1 was developed. This table indicates temperatures to the heat pump ranging from −7.5 to 62.5 deg F and with 10 and 20 deg average rise through solar collector and/or storage. Using these values for supplemented source conditions, corresponding increases for heat pump CP and capacity were obtained from the manufacturers' performance curves for supplemented source air conditions. A relative decrease in energy consumption of the electrical resistance heaters used as standby is readily apparent. From these factors and the house heating demand, the total power requirement at that temperature level may be determined. Typical sample calculations for the development of this table are included in the Appendix.

A further analysis was made of climatological data[4] (Table 2) to determine the number of hours heating would be required at the respective temperature levels. A Technical Advisory Committee winter design temperature of 5 F was considered for this particular study.

The values obtained and reported in Tables 1 and 2 were plotted as Fig. 5. The curves show the annual hours of heating required at various outdoor temperatures plotted against the corresponding electric energy consumption of an air-source heat pump alone and with solar supplement. The area under the respective curves represents the total seasonal energy requirement in kwhr. The area between the curves represents the energy saved by solar supplemen-

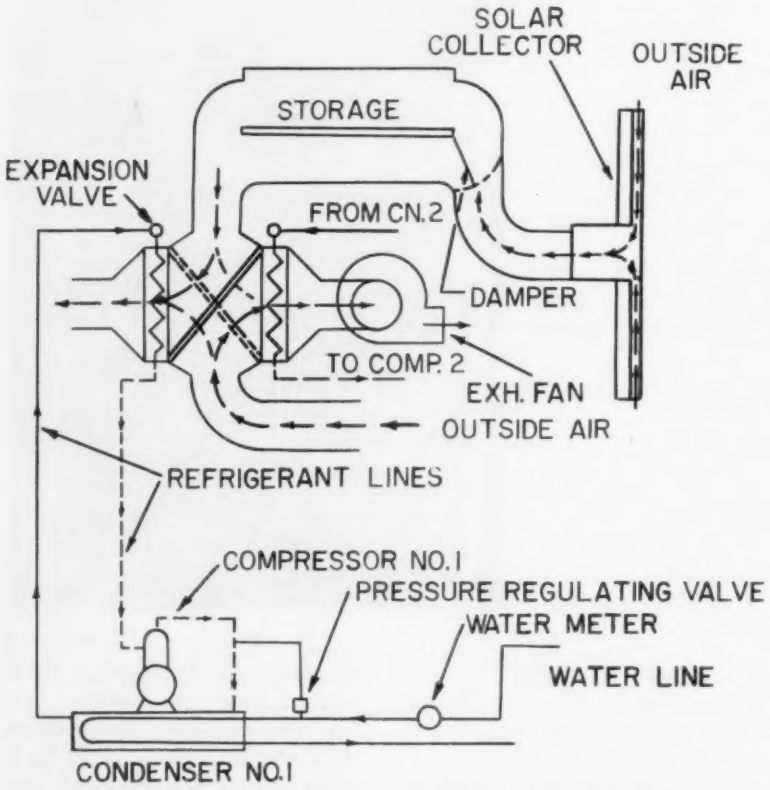

Fig. 3 — Schematic of solar supplemented heat-pump system with storage

Table 2 — Degree hours based on TAC of 5 F

	Hours	Multiplier Degrees	Degree Hours
0<t<5	50-0 = 50	62.5	3,125
5<t<10	100-50 = 50	57.5	2,875
10<t<15	250-100 = 150	52.5	7,875
15<t<20	450-250 = 200	47.5	9,500
20<t<25	775-450 = 325	42.5	13,813
25<t<30	1200-775 = 425	37.5	15,938
30<t<35	1775-1200 = 575	32.5	18,688
35<t<40	2550-1775 = 775	27.5	21,313
40<t<45	3350-2550 = 800	22.5	18,000
45<t<50	4050-3350 = 700	17.5	12,250
50<t<55	4675-4050 = 625	12.5	7,813
55<t<60	5400-4675 = 725	7.5	5,438
60<t<65	6100-5400 = 700	2.5	1,750

Table 3 — Number of defrosts per year

	Technical Advisory Committee Temperatures (F)												
	−10 to 5	6-8	9-11	12-14	15-17	18-20	21-23	24-26	27-29	30-32	33-35	36-38	39-40
Normally Dry	475	450	400	375	350	300	250	200	175	150	100	75	50
Normally Damp	800	750	700	625	575	500	425	350	300	225	175	125	100
Average	637	600	550	500	462	400	337	275	237	212	137	100	75

Table 4 — Balance point defrost factor

Balance Point	Technical Advisory Committee Temperatures (F)		
	−10 to 10	11 to 25	26 to 40
10-15	0.50	0.45	0.40
16-20	0.60	0.55	0.45
21-25	0.75	0.65	0.55
26-30	0.85	0.75	0.65
31-35	1.00	1.00	0.80
36-40	1.00	1.00	1.00

tation. The area between curves was found to be 1200 kwhr or approximately 6 percent of the usual unsupplemented requirement. This was for a region in which 6500 degree-day heating was required and where the solar heat added to the air produced an air-source temperature 10 deg above that of the ambient air. For a 20 deg rise above ambient, this saving amounted to 12 percent.

Reduction of Coil Defrost

A desirable *by-product* of supplementation has been the reduction of defrost periods necessary. Limited observation indicates this reduction may be as high as 75 to 80 percent. It was reported from studies of field installations by manufacturers of equipment that the number of defrost periods is proportional to the TAC design temperature, the generalized normal-humidity level (Table 3)[4] and a balance-point defrost factor (Table 4).[4]

For conventional equipment defrost, heat is extracted from the heated space and rejected to the outdoor coil to melt the frost or ice. This then represents a heat loss to the space. The loss amounts to approximately 2000 Btu per nominal horsepower for each defrost.

When considered for the entire heating season, this amounts to an appreciable heat loss which must be supplied by additional equipment operation.

A reduction approaching 2 percent in operating energy could be realized by eliminating the necessity for defrost. Perhaps more important is the probability of reduction of maintenance and servicing problems occasioned by icing and the possible reduction or elimination of defrosting equipment components.

Results of System Tests

In operations during the winter of 1955-56, without storage, an average increase in performance (CP) of 15 percent and in capacity of 16 percent was noted during several weeks of daytime operation. These results were obtained for a variety of solar-reception conditions ranging from clear to cloudy weather. During the most cloudy period, the increase in performance of the heat pump due to solar supplementation amounted to 6 percent with an increased capacity of 13 to 14 percent.

Studies during the winter of 1956-57, after the addition of storage, revealed that the solar collector and storage were providing an increase in air temperature to the heat pump varying between 12 and 23 deg.

Continuous operation of the 2 systems during two 3-week periods in January and February showed that the CP of the supplemented heat pump averaged 17.5 percent higher than that of the unit using outside air as a source.

Measurement of total flow (by volume water meter) to a water-cooled condenser combined with temperature rise provided comparable heat-output information. The electric energy input required to produce the effects was measured by calibrated conventional kwhr meters that could be read to 1/100 kwhr accuracy.

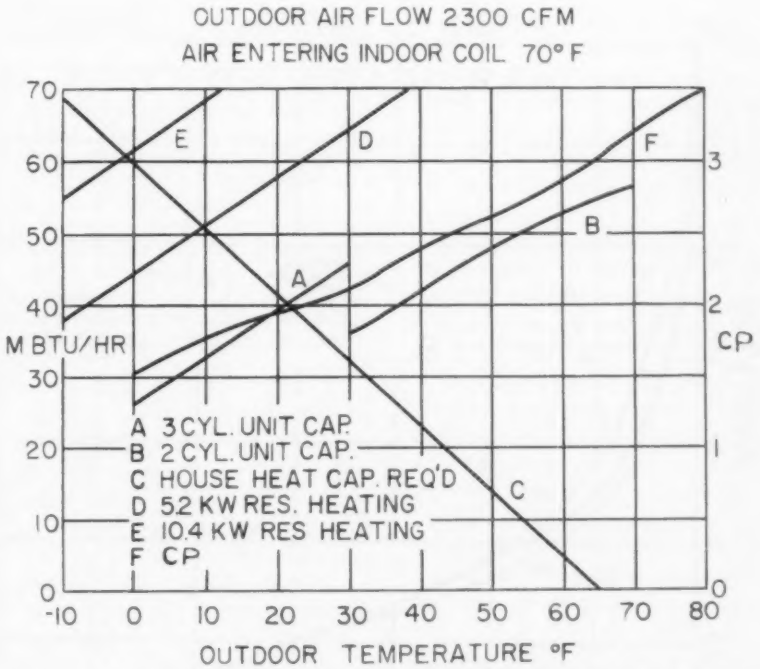
OUTDOOR AIR FLOW 2300 CFM
AIR ENTERING INDOOR COIL 70° F
M BTU/HR
CP
A 3 CYL. UNIT CAP.
B 2 CYL. UNIT CAP.
C HOUSE HEAT CAP. REQ'D
D 5.2 KW RES. HEATING
E 10.4 KW RES HEATING
F CP
OUTDOOR TEMPERATURE °F

Fig. 4 — Performance characteristics of commercially produced air-type heat pump used as basis for hypothetical analysis

Journal Section

Planned Operation

For operations during the winter of 1957-58 the systems are being modified to provide operation in accordance with actual heating demand for existing weather conditions rather than continuous operation as heretofore studied. The blower, under differential-thermostat control, provides circulation of air from the collector through storage when solar energy is being collected and can be stored. This blower is also interlocked to move air through storage and over the evaporator regardless of whether solar collection is taking place when heating is required.

In theory it should be possible to increase significantly the quantity and temperature level of heat in storage and the temperature rise that can be provided the air en route to the heat pump over that obtained under previous continuous operating conditions.

Economic Considerations

The results of theoretical and practical studies to date have indicated that the economic advantage of improved equipment operation obtained through the use of solar energy supplementation will be offset by extra construction costs of collectors, storage, and required controls. Depending upon how well these features can be worked into an architectural plan, their costs may be amortized over a 3- to 5-year period.

Conclusions

Incorporation of a solar collector and storage with the conventional air-type heat pump can be accomplished with a minimum of system addition and change. Use is made of the south-facing building walls as part of collector construction. Yet to be fully assessed, but definitely demonstrated, has been the reduction and simplification of coil defrost problems.

Solar-energy supplementation with storage has provided a heat-source air-temperature increase ranging between 10 and 20 deg for the air-source heat pump. Significant increases in both heat pump capacity and CP have reduced operating costs over those obtained with an identical conventional unit using outside air as a heat source and offer enough advantage to warrant continued development. Further improvements in collector and storage efficiency through design are possible. Whether they may be accomplished without disproportionately increasing supplemental equipment costs relative to operational energy savings is still under study.

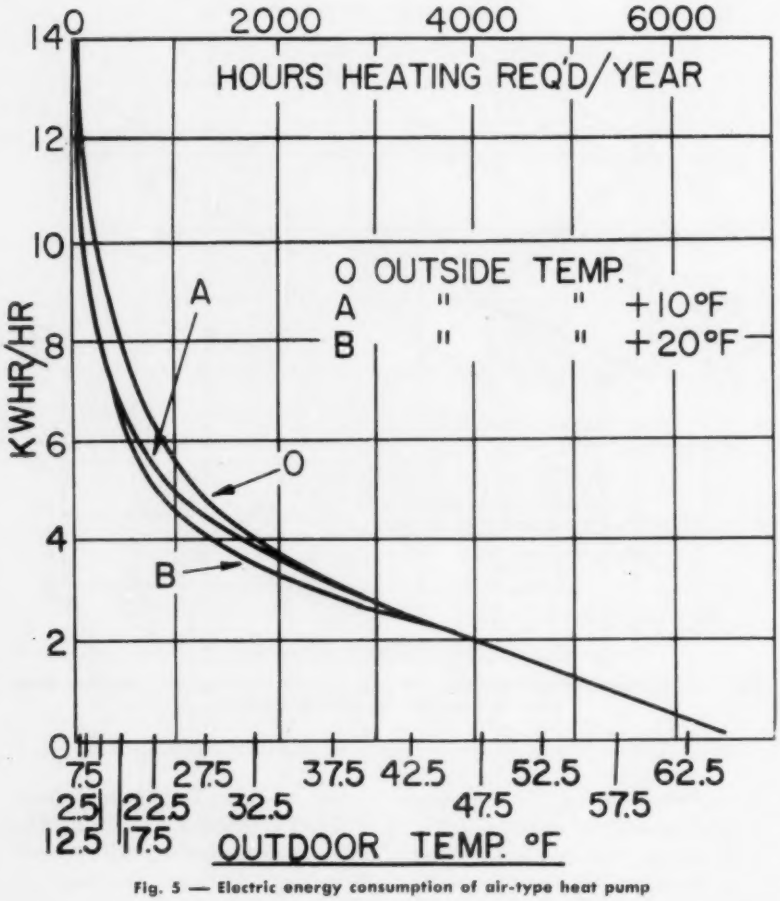

Fig. 5 — Electric energy consumption of air-type heat pump

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APPENDIX

Heating requirements for a house of approximately 12,000 cu ft with a heat loss as indicated in Fig. 4 were anticipated.

Sample calculations are for the kwhr per hour required for an outdoor temperature, t, where $5F < t < 10$ F.* From Table 1 and Fig. 4 and 7.5 F the heat pump capacity alone is 31.3 M Btu per hr at a CP of 1.72. The energy for operation of the heat pump is therefore 31,300/3,413(1.72) = 5.33 kwhr.

Referring again to Fig. 4, it was apparent at this temperature that the house assumed would require 53 M Btu per hr. The difference between 53 and 31.3 M Btu per hr must be supplied by electrical resistance or 53 − 31.3 = 21.7 M Btu per hr.

Therefore, the energy required to produce this heating effect is 21,700/3,413 or 6.35 kwhr per hr. When combined with the energy for operation of the heat pump, a total energy of 5.33 + 6.35 or 11.68 kwhr per hr was determined.

Similarly, where a 10 deg temperature rise results from solar collection, the capacity of the heat pump now corresponds to that at which the outdoor temperature is 15 F $< t <$ 20 F in which case the capacity of the unit is 38 M Btu and the CP 1.92. For heat pump operation, as calculated previously, 5.8 kwhr per hr electrical energy is required. The heat loss of the house remains at 53 M Btu per hr of which 53 − 38 = 15 M Btu per hr must now be supplied by electrical resistance heating or 4.4 kwhr per hr.

A new factor of 0.28 kwhr per hr was calculated as additional fan energy necessary to move the air through the collector and storage to the heat pump unit. The total energy consumed, therefore, for the 10 deg rise is 5.8 + 4.4 + 0.28 = 10.48 kwhr per hr.

*Mathematical symbolism that t lies between 5 F and 10 F or, stated another way, that t is greater than 5 F and less than 10 F.

Natural Convection Cooling and Dehumidifying

By L. G. Seigel*, Erie, Pa., and W. L. Bryan†, Cleveland, Ohio

SUMMARY — This article presents the results of tests conducted to obtain data on natural convection cooling equipment.

Tests were run on bare and finned single tubes and on complete *gravity coil units*. Performance was studied for conditions of sensible cooling as well as for conditions of dehumidification. Applications of the results for single tubes and full size coil units to practical air conditioning problems are given. Methods of control are also discussed.

BASIC DATA for the design of natural convection cooling equipment which may be required for certain applications have not been available. Therefore, this investigation was undertaken to establish such data so that the performance of gravity type cooling and dehumidifying equipment might be predicted.

In order to accomplish this purpose, data were obtained from tests of both bare and finned single tubes and from tests of full size *gravity coil units*. All tests were run in the range of comfort air conditioning, and both sensible cooling and dehumidification were studied.

Description of Equipment Tested

The cooling equipment tested consisted of the following items:

1. One horizontal bare tube.
2. One horizontal finned tube.
3. One complete gravity cooling coil.

The bare tube was a ½-in. nominal size copper tube, 66.5 in. long. The actual outside diameter was 0.686 in. and the inside diameter was 0.605 in.

The finned tube was a copper tube, 67.5 in. long, and 0.638 in. outside diameter. The inside diameter was 0.590 in. The tube was fitted with aluminum fins spaced 3.12 per inch. The fins were 0.0095 in. thick and 2.0 in. square. Fig. 1, is a photograph of a section of this tube. After completion of one set of tests for this tube, the fin spacing was doubled by removing every other fin, and the tests were repeated. Thus, two fin spacings were tested. The gravity coil was a 5G Standard Navy Gravity Cooling Coil. It had a surface area of 128 sq ft obtained by using 0.020 in. thick aluminum fins spaced 3 per in. on two horizontal rows of ⅝-in. copper tubes.

Test Method and Procedure

The gravity coil was installed in a thoroughly instrumented metal-lined test room as shown in Fig. 2. Heat and moisture were supplied to the room by electric heaters and evaporators. Room dry-bulb temperatures were determined by means of vertically spaced thermometers and thermocouples as shown in the figure. For measuring relative humidity, 2 aspirating psychrometers were used. One was equipped with a sampling tube to measure the average condition in the space and the other was set to measure local humidity near the observation window.

Water temperatures were measured by mercury thermometers installed at the water inlet and outlet of the coil. This temperature difference across the coil was used with the water flow rate to determine the total coil load. Latent load for the space was determined by measuring the condensate collected by the drip pan and this value was checked against the weight of water evaporated by the electrical evaporators.

The space sensible heat load was then computed as the difference between the coil heat load and the heat equivalent of the collected condensate removed from the room.

The single tubes were tested in the same test space and by similar methods. However, during the single tube tests, an *equipment access wall* was used instead of the observation window. All instrumentation and flow connections were made through this wall so that the need for entering the test room was minimized.

Results of Tests

For the single tubes, the results of heat transfer tests were found to agree with the following equation for both bare and finned tubes:

$$h_c = 0.29\ (t_s - t_a/L)^{1/4} \quad \ldots\ldots(1)$$

A plot of the test results and of this equation is shown in Fig. 3.

Results of tests when mass transfer was involved were not so consistent as those for heat transfer due to difficulties encountered in measuring the small condensate quantities and due to re-evaporation of the condensate from the collection pan. These results are shown in Table 1.

The mass transfer may be determined from the following equation using values of K_c from Table 1.

$$M_c = K_c A_c (w_s - w_a) \quad \ldots\ldots(2)$$

*Director, Engineering Department, Gannon College. Associate Member of ASHAE.
†Associate Professor of Heat Power, Case Institute of Technology. Member of ASHAE.
For presentation at the 64th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, Pittsburgh, Pa., January 1958.

For the full size gravity coil, the test results are shown in Fig. 4. The points show considerable scatter, probably due to the difficulties encountered in making accurate measurements of very small heat and moisture quantities. However, a definite trend was established, and reasonable agreement is demonstrated with data obtained previously from tests of a similar coil using Refrigerant-12 as the refrigerant instead of water.

In the interpretation of the results for the gravity coil, it will be helpful to present the factors affecting the performance of natural convection cooling equipment.

When a gravity cooling coil is installed in a space both the heat removed by the coil and the mass or condensed water removed from the space must be considered. It was experimentally observed that all the vapor converted to water at the coil surface does not appear as removed condensate since some evaporates from the drip pan and some is bypassed in the form of fog or moisture particles.

The presence of an unknown amount of fog and the re-evaporation of moisture from the coil surface and drip pan complicates the problem to the extent that the actual states of the air entering and leaving the coil are not known. Therefore, it is not possible to evaluate coil performance in the usual way. In order to overcome this difficulty and to permit coil computations to be based on average space air conditions, it is convenient to consider the coil to be in series with an adiabatic evaporator to take care of the by-passed fog and moisture. Through the operation of this imaginary evaporator, the average space air condition is converted into an unknown state at the coil.

Based on these considerations, the heat and mass transfer rates are specified by unit heat and mass transfer factors for the coil rather than by the familiar coefficients. The process of fog recirculation from coil exit to entrance can be accounted for by these unit transfer factors as indicated by the equations which follow.

The sensible heat removed from the space may be expressed as:

$$Q_s = (hA)_u\ (t_a - t_s) \quad \text{.....(3-a)}$$

or

$$Q_s = h_c A_c\ (t_1 - t_s) + CM_v h_{fg} \quad \text{.....(3-b)}$$

The latent heat removed from the space depends directly on the mass transfer relations as follows:

$$Q_L = (1 - C)\ M_v h_{fg} \quad \text{.....(4-a)}$$

$$Q_L = (KA)_u\ (w_a - w_s)\ h_{fg} \quad \text{..(4-b)}$$

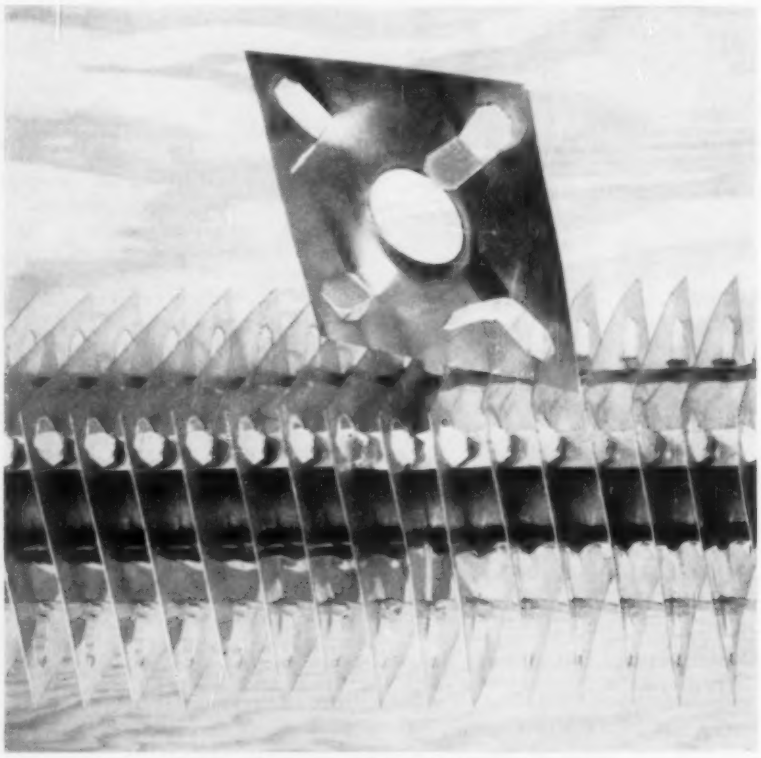


Fig. 1 — Photograph of finned tube used in tests

Nomenclature

A = surface area, square feet.
A_c = heat or mass transfer surface area of coil or tube, square feet.
C = mass fraction of condensed water re-evaporated.
ΔW = humidity ratio difference, pounds of water per pound of dry air.
h_c = convection heat transfer coefficient, Btu per (hour) (square foot) (Fahrenheit degree).
h_{fg} = latent heat of vaporization of water (1060) Btu per pound.
h_r = coefficient of radiant heat transfer, Btu per (hour) (square foot) (Fahrenheit degree).
h_t = sum of convection and radiant coefficient, Btu (hour) (square foot) (Fahrenheit degree).
$(hA)_u$ = unit heat transfer factor, Btu per (hour) (Fahrenheit degree).
K_c = mass transfer coefficient, pounds per (hour) (square foot) Δ W.
$(KA)_u$ = unit mass transfer factor, pounds of water per hour Δ W.
L = height of heat path, feet*.
M_v = coil or tube mass transfer, pounds per hour.
Q_c = latent heat removed by coil.
Q_L = latent heat removed from the space, Btu per hour.
Q_s = sensible heat removed from the space, Btu per hour.
t_a = space dry-bulb temperature, Fahrenheit.
t_s = coil or tube surface temperature, Fahrenheit.
t_1 = dry-bulb temperature of air entering coil, Fahrenheit.
T_a = space dry-bulb temperature, Fahrenheit absolute.
T_s = coil or tube surface temperature, Fahrenheit absolute.
w_a = space humidity ratio, pounds of water per pound of dry air.
w_1 = humidity ratio of air entering coil, pounds of water per pound of dry air.
w_s = humidity ratio of saturated air at coil or tube surface temperature, pounds of water per pound of dry air.
σ = 0.171 = radiation constant.
ϵ = emissivity factor.

*This is the outside tube diameter for bare tube and fin height for finned tube.

$$Q_L = K_c A_c (w_l - w_s) - CM_v h_{fg} \quad \text{.....(4-c)}$$

If the re-evaporation or fog by-pass is reduced to zero, Equations 3-b and 4-c become the familiar heat and mass transfer equations, and computations may be made in the usual manner. However, for gravity coils, the by-passed moisture is not an insignificant value, and computations must be based on unit factors through equations of the form given in Equations 3-a and 4-b.

In the range of $(t_a - t_s)$ tested (about 30 to 40 F) the heat transfer factor divided by the coil surface area has been found to be close to unity throughout the range. However, the mass transfer factor becomes substantially zero (as indicated in Fig. 4) at a humidity ratio difference of approximately 35 grains per pound of dry air.

The practical significance of re-evaporation as brought out in Fig. 4, is that for space latent heat loads of zero or near zero the specific humidity difference $(w_a - w_s)$ will be approximately 35 grains. This potential difference is set up by fog by-pass and the moisture which is re-evaporated. If this were not the case, the dew-point in the space would approach the temperature of the coil surface when the space latent load is reduced to zero.

would be the case in an airtight compartment after closing it for storage, the difference in absolute humidity depends on the temperature difference between dry-bulb and refrigerant. It has been experimentally determined

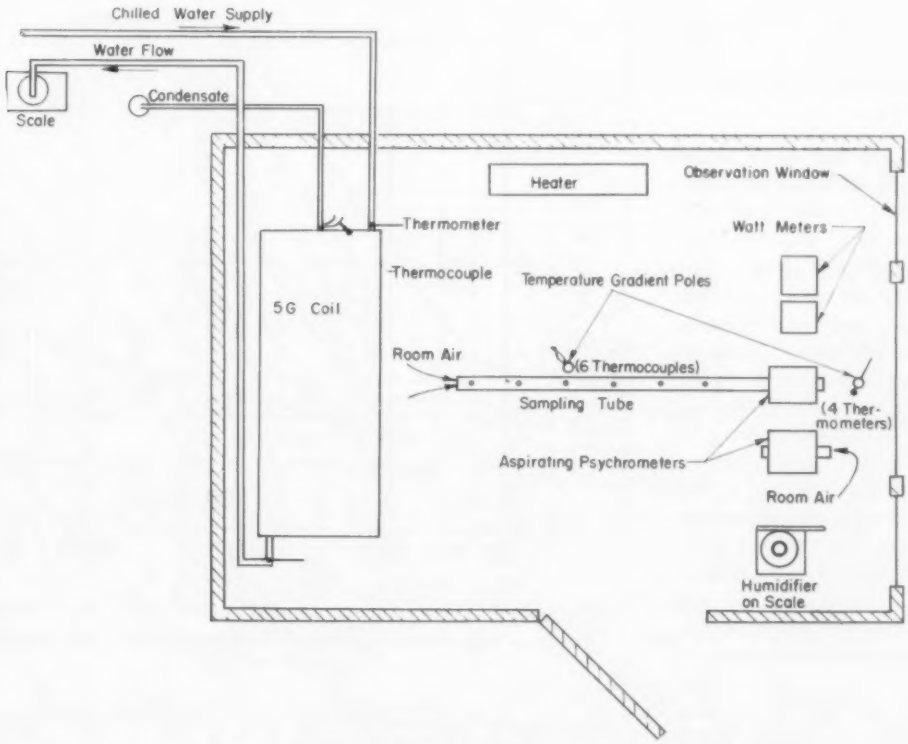


Fig. 2 — Schematic diagram of setup for testing gravity coils

Discussion of Results

The results of these tests indicate that, for constant sensible and latent loads, the minimum absolute humidity that can be maintained in a space cooled by the gravity cooling coil tested is about 35 grains per pound of dry air higher than the humidity corresponding to the refrigerant temperature. This means that the minimum space dew-point that can be maintained by cooling with gravity coils will be about 60 F when using chilled water at 45 F as refrigerant.

However, if the latent load is not constant and is reduced to zero as from unsteady-state tests conducted during this investigation, that the *humidity pull-down* or residual absolute humidity that can be maintained in a space having a zero continuous latent load will be 0.75 grains per pound of dry air higher than the humidity corresponding to the refrigerant temperature, for each Fahrenheit degree difference in temperature between the space dry-bulb and the refrigerant. For example, a space fitted with this gravity coil operating at 50 F refrigerant and a dry-bulb of 80 F would have a minimum absolute humidity of 0.75 (80 − 50) = 22.5 grains per pound of dry air higher

than the humidity corresponding to 50 F. This is 54 + 22.5 = 76.5 grains per pound of dry air. This relation is valid until approximately 35 grains difference is reached. For differences greater than 35 grains, it is no longer possible to maintain zero latent load and the steady-state performance of Fig. 4 applies.

Application of Results of Full Size Coil Tests

To simplify the application of the results obtained from this investigation, a performance chart similar to that shown in Fig. 5 may be drawn for any particular coil design. This chart may then be used for all applications where there are continuous latent and sensible loads to be handled. If the latent load should be reduced to zero as might be the case when storing dry products for prolonged periods, the space conditions which will be maintained depend upon the re-evaporation characteristics of the space and the coil as described under Discussion of Results.

To illustrate the use of the coil data presented in this paper, the following examples have been prepared:

Example 1: *A space used for storage is to be maintained at 76 dry-bulb and 50 percent relative humidity. The sensible heat gain for the space is 8400 Btu per hr, and there is no ventilation or latent heat load during storage. Before closing, the space was ventilated with air at 96 dry-bulb and 75 wet-bulb. Chilled water is available at 50 F for cooling. Select a gravity coil to maintain the space at the storage conditions.*

Solution: 1. From Fig. 5, the coil capacity for 50 F water is found to be 22 Btu per (hr) (sq ft) at 76 dry-bulb.

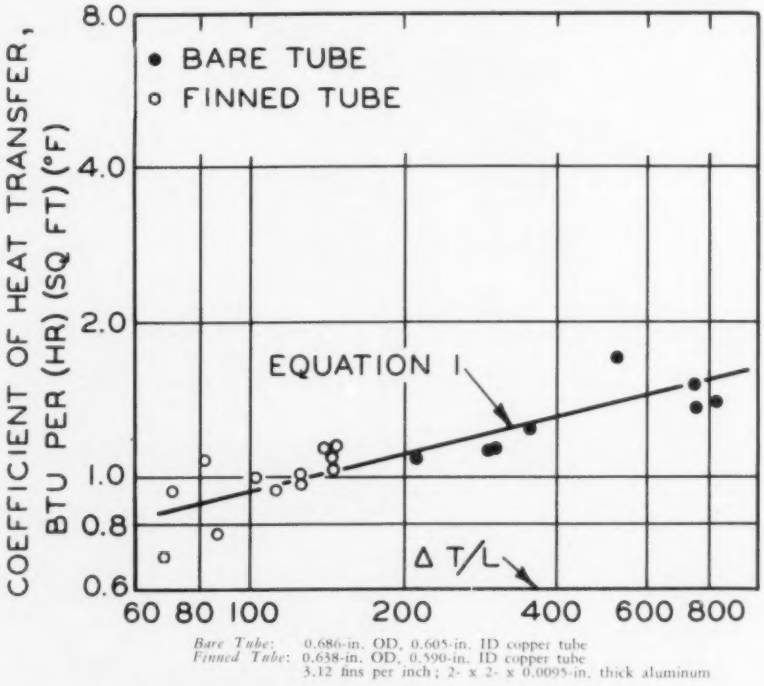
2. To carry a load of 8400 Btu per hr then 8400/22 = 384 sq ft of coil surface are required.

3. The absolute humidity in the space will be determined by the difference between the space dry-bulb and the refrigerant temperature. For the temperature difference (76 − 50), the space absolute humidity will be 26 × 0.75 = 19.5 grains per pound of dry air above the humidity corresponding to 50 F refrigerant temperature. Therefore, the space absolute humidity will be 54 + 19.5 = 73.5 grains per pound of dry air.

4. At 76 dry-bulb and 73.5 grains per pound of dry air, the relative humidity is 56 percent, which is higher than the 50 percent required. If the 56 percent humidity is not satisfactory, the water temperature must be reduced, or the condition cannot be met by use of gravity coils of this design using a water temperature of 50 F.

5. If the water temperature is reduced to 45 F, the absolute humidity would be 0.75 (76 − 45) + 44 = 67 grains per pound of dry air, and the relative humidity at 76 dry-bulb would be 50 percent. Therefore, the condition could be met with 45 F water instead of 50 F.

For automatic control under light load conditions, reheat should be used regulated by dry-bulb thermostat. Control by cycling the coil is not recommended because it would cause high humidity during the *off* periods.



Bare Tube: 0.686-in. OD, 0.605-in. ID copper tube
Finned Tube: 0.638-in. OD, 0.590-in. ID copper tube
3.12 fins per inch; 2- x 2- x 0.0095-in. thick aluminum

Fig. 3 — Heat transfer coefficients for gravity cooling with horizontal bare and finned tubes

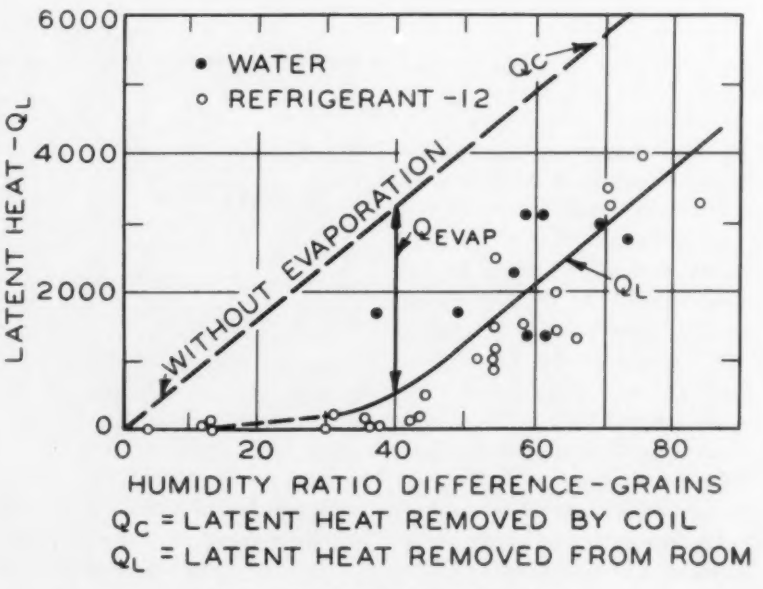


Fig. 4 — Test results for gravity coil

Example 2: Assume that the space in Example 1 has a continuous latent load of 2000 Btu per hr and that the sensible load is 9500 Btu per hr. Let the required space condition be 85 dry-bulb and 65 percent RH (relative humidity) (118 grains). Chilled water is available at 50 F. Select a gravity coil to maintain the space conditions and prescribe a method of control.

Solution: 1. From Fig. 5, the sensible load is 31 Btu per hr (sq ft) at 85 dry-bulb and 50 F refrigerant and the latent load is 15.6 Btu per (hr) (sq ft) at 118 grains and 50 F refrigerant.

2. For the sensible load, 9500/31, or 307 sq ft of coil surface are required, and 2000/15.6, or 128 sq ft are needed for the latent load. A standard coil size of 335 sq ft may be selected.

3. If the latent load is constant at 2000 Btu per hr, the coil latent load per square foot will be 2000/335 = 6.0. According to Fig. 5, this loading can be carried with 50 F refrigerant temperature when the space humidity is 103 grains. Therefore, the space will come to equilibrium at 58 percent RH when the dry-bulb temperature is 85 F. If less than 65 percent RH is not satisfactory, some type of humidification will have to be added to raise the space humidity since the coil area in this case is determined by the sensible load.

4. If it is desired to maintain exact space conditions at all times, elaborate control methods are required to provide both reheat and re-humidification. However, if it is necessary only to maintain humidity *below* a specified value, the control system may be simplified. To meet these requirements, it should be possible to have a space humidistat regulate the chilled water valve in parallel with a dry-bulb thermostat. For conditions where the sensible load is light and the latent load is high, the humidistat would call for more water than required to maintain the dry-bulb and reheat would be required (from an auxiliary thermostat or a low limit position of the dry-bulb thermostat regulating the water). For high sensible loads with light latent loads, the dry-bulb thermostat would control the water flow and the humidity in the space would be lower than the setting of the humidistat.

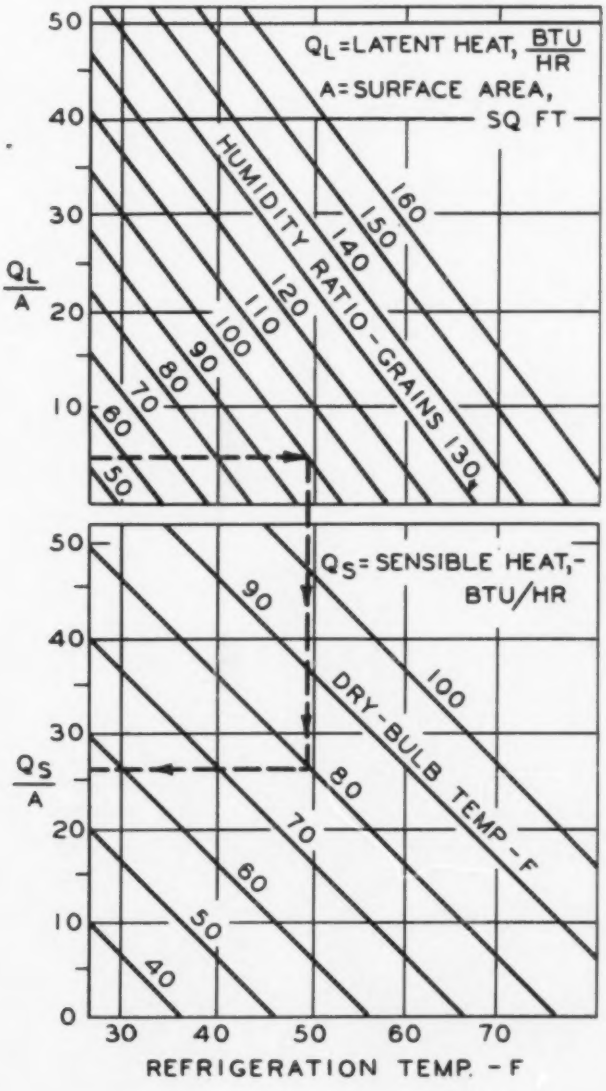


Fig. 5 — Performance chart for gravity cooling coil. T_R is the inlet water or Refrigerant-12 suction temperature in Fahrenheit degrees

Application of Results of Single Tube Tests

In the case of the single tubes tested, fog by-pass was not evident within the range of refrigerant temperatures used. Re-evaporation relative to the space volume was small so that the room condition was considered equivalent to the condition of the air passing over the tube. Under these conditions it was possible to determine the re-evaporation by actual measurement and Equation 3-b could be used. Then, by substituting the mass transfer equivalent for the re-evaporation, Equation 3-b may be written as:

$$Q_s = h_t A_c (t_a - t_s) + CK_c A_c (w_a - w_s) h_{fg} \quad ..(5)$$

Note that h_t has been substituted for h_c to include the radiation as well as the convection heat transfer. Thus, Equation 5 gives the total sensible heat transferred from the space by the tube-drip pan combination.

The latent heat transfer for single tubes may be expressed by the following equation:

$$Q_L = (1 - C) K_c A_c \times (w_a - w_s) h_{fg} \quad .....(6)$$

The mass fraction of condensed water re-evaporated for the single tubes has been designated in Equations 5 and 6 by C. This factor, which depends on the rate of condensation and the design of drip pan, had approximate values of 0.5 for the bare tube and 0.1 for the finned tube over the range covered in these tests.

Journal Section

Use of the foregoing equations for single tubes will be demonstrated by an example which follows:

Example 3: Computations for a ⅝-in. OD Bare Tube. Assume conditions as follows: Room Ambient; 85 dry-bulb, 70 wet-bulb, 63 dew-point. Load: Total heat = 5500 Btu per hr; Sensible heat = 4400 Btu per hr; Latent heat = 1100 Btu per hr; Load ratio = 0.8. Refrigerant: Chilled water at mean temperature of 45 F.

Procedure for Solution: 1. The mean surface temperature of the tube, for practical purposes, may be considered equal to the mean water temperature, 45 F. This is accurate to about 2 percent for a bare tube.

2. It is next necessary to account for the sensible heat transfer by radiation. This may be done by use of a radiation coefficient which is added to the convection heat transfer coefficient.

The radiation coefficient is calculated by the equation:

$$h_r = [\sigma e (T_s^4 - T_a^4)]/(T_s - T_a) \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

For this example,

h_r = 0.9 Btu per (hr) (sq ft) (Fahrenheit degree).

3. The coefficient for convection heat transfer is calculated from Equation 1 or taken from Fig. 3.

h_c = 1.5 Btu per (hr) (sq ft) (Fahrenheit degree).

4. The combined coefficient for convection heat transfer plus radiation is then:

$h_t = h_r + h_c$ = 2.4 Btu per (hr) (sq ft) (Fahrenheit degree).

5. The coefficient of mass transfer, K_c, is obtained from Table 1 for the bare tube.

K_c = 6.5 lb H_2O per (hr) (sq ft) (lb H_2O per lb dry air)

6. The required area of the bare tube can now be calculated by using Equation 5. [$(w_a - w_s)$ = 0.006, from air-vapor tables.]

$$4400 = (2.4)(A_c)(40) + (0.5)(6.5)(A_c)(0.006)(1060)$$

A_c = 37.7 sq ft surface area

7. The heat and mass transferred are then:

Q_s (heat by radiation, convection, plus evaporation) = 4400 Btu per hr.

$Q_L = (1 - C) K_c A_c (w_a - w_s) h_{fg}$
$= (1 - 0.5)\ 6.5 \times 37.7 \times 0.006 \times 1060 = 779$ Btu per hr

Total heat transfer = 4400 + 779 = 5179 Btu per hr.

load ratio = 4400/5179 = 0.85

From these results it is seen that the required conditions cannot be met unless reheat is used (assuming that the water temperature cannot be reduced).

Table 1 — Results of combined heat and mass transfer tests

Average Temperatures, F				Heat Removed by Tube Btu/hr			Transfer Coefficients	
Tube Surface	Water	Room Dry-Bulb	Room Dew-Point	Radiation	Convection	Condensation	Heat, Btu per (hr) (sq ft) (F deg)	Mass, lb H_2O per (hr) (sq ft) (lb H_2O per lb dry air)
Performance of a Single Bare Copper Tube Cooling Air by Natural Convection Tube Size: 0.686 in. OD, 0.605 in. ID, 66.5 in. long								
52.5	48.2	89.3	70.1	19.1	53.4	45.6	1.45	5.8
52.1	46.8	94.8	73.4	22.5	64.0	89.4	1.50	8.9
51.6	46.4	95.9	73.2	23.3	67.3	87.9	1.52	8.8
46.7	42.1	83.9	63.5	18.5	53.9	57.6	1.45	6.2
47.1	42.3	84.5	61.9	18.8	54.3	28.5	1.45	5.6
46.0	43.2	82.0	51.3	17.9	51.8	5.5	1.44	5.6
46.3	43.8	80.2	53.7	16.7	48.5	9.9	1.43	4.5
48.0	44.8	84.5	59.3	18.4	52.5	31.9	1.44	8.2
Performance of a Single Horizontal Aluminum-Finned Copper Tube Tube Size: 0.638 in. OD, 0.590 in. ID, 67.5 in Exposed Length; Fin Size: 2 x 2 x 0.0095 in.; 3.12 Fins Per Inch; Surface Area: 11.75 sq ft								
69.5	49.7	87.1	78.0	63.7	208	225	1.0	3.5
67.4	44.8	87.4	81.6	71.1	256	210	1.1	2.0
69.7	58.5	87.4	79.3	62.9	212	296	1.0	4.1
68.0	54.5	89.6	84.8	76.6	266	372	1.1	2.6
73.0	54.2	89.7	84.2	59.2	205	222	1.0	2.3
Performance of a Single Horizontal Aluminum-Finned Copper Tube Tube Size: 0.638 in. OD, 0.590 in. ID, 67.5 in. Exposed Length; Fin Size: 2 x 2 x 0.0095 in.; 1.56 Fins Per Inch								
59.2	45.0	86.4	84.5	99	179	499	1.04	5.0
65.2	53.3	88.0	88.0	81	143	483	0.99	4.5
68.3	58.5	87.7	85.0	71	117	402	0.95	5.3
77.0	66.1	91.6	91.3	55	82	383	0.89	4.7
75.9	64.0	92.9	92.2	64	99	489	0.92	5.3

Note: The effect of fin spacing on mass transfer is shown by the last part of the above table. Increasing the fin spacing decreased the moisture concentration between fins and caused an increase in coefficient.

8. To meet the required condition, the tube area should be determined on the basis of the latent heat load. The required area is then:

A_c = 1100/(0.5) (6.5) (0.006) (1060) = 53.2 sq ft

9. The heat and mass transferred are then: Sensible heat = 6207 Btu per hr; Reheat added to space = 1807 Btu per hr; Net sensible heat = 4400 Btu per hr; Latent heat = 1100 Btu per hr. Total heat removed by coil = 7307 Btu per hr; the Space load ratio = 4400/5500 = 0.8. Therefore, 325 ft of ⅝ in. OD tubing is required, representing 53.2 sq ft of surface area.

Acknowledgment

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Direct Solar Radiation Available on Clear Days†

By J. L. Threlkeld* and R. C. Jordan**, Minneapolis, Minn.

SUMMARY — This paper presents the results of research on the incidence of direct solar radiation during clear days in the United States. A fundamental procedure for determining atmospheric transmission factors for various atmospheric conditions and for various elevations is presented. A more approximate procedure involving the concept of a basic atmosphere together with atmospheric clearness numbers is also presented. Correlations with observed solar radiation at several localities are included.

Engineering and scientific problems involved with the irradiation of surfaces on the earth by the sun are continually increasing. In this country and abroad, research on fundamental and applied topics on harnessing of solar energy in thermal, electrical, and chemical processes is expanding. In the field of thermal utilization of solar energy, some applications are already of commercial practicability. The solar furnace[1] is becoming an important research tool in the production of controlled high temperatures, while in the realm of low temperature utilization, solar energy has been put to commercial use in the space heating of buildings.[2]

Of equal interest and at the present time of greater economic importance is the minimizing or prevention of entry or incidence of solar radiation. In the expanding field of summer air conditioning, solar radiation may represent a sizable portion of the cooling load. Shading devices of various types and reflecting surfaces are used to reduce the heating effect of the sun's rays.

In all types of solar radiation problems, regardless of whether they involve utilization or control, quantitative knowledge of incident solar energy is needed. Solar energy availability knowledge is needed for all types of solar weather including clear, partly cloudy, and cloudy days.

Clear-day knowledge of solar availability is of much importance. In the field of solar energy control, design problems involve clear days when solar effects are large. In solar energy utilization problems, apparatus is often designed for clear-day operation. In addition, a study of clear-day radiation is a logical start into the problem of incidence of solar energy on partly cloudy and cloudy days.

In most solar energy problems, knowledge of both direct and diffuse radiation is needed. In the case of concentrating devices, such as a solar furnace, only direct or beamed radiation is utilized. During clear days the diffuse component is usually small when compared to the direct component.

This paper is concerned only with the incidence of direct solar radiation during clear days. An associated paper on diffuse radiation is planned for future publication.

Nomenclature

$C.N.$ = atmospheric clearness number, ratio of direct solar radiation at normal incidence for locality to that for basic atmosphere, dimensionless.
d = number of atmospheric dust particles per cubic centimeter
I_H = incidence of direct solar radiation upon a horizontal surface, Btu per (hour) (square foot).
I_N = incidence of direct solar radiation upon a surface perpendicular to sun's rays, Btu per (hour) (square foot).
I_o = incidence of solar radiation upon a surface perpendicular to sun's rays at outer limit of atmosphere, Btu per (hour) (square foot).
I_{sc} = the solar constant; incidence of solar radiation upon a surface perpendicular to sun's rays at outer limit of atmosphere and at the mean solar distance, 442.4 Btu per (hour) (square foot).
I_{TV} = incidence of direct solar radiation upon a surface tilted from the vertical position, Btu per (hour) (square foot).
I_V = incidence of direct solar radiation upon a vertical surface, Btu per (hour) (square foot).
m = air mass, ratio of length of path of sun's rays through atmosphere to vertical length of path when sun is in zenith position, dimensionless.
o = depth of atmospheric ozone (NTP), millimeters.
p = barometric pressure, millimeters of mercury.
TF = atmospheric transmission factor, dimensionless.
w = depth of atmospheric precipitable water, millimeters.
a = wall-solar azimuth angle; angle between horizontal projection of sun's rays and perpendicular to vertical wall.
β = altitude angle of sun.
γ = azimuth angle of sun; angle measured from north to horizontal projection of sun's rays.
μ = wavelength, microns.
τ = total spectral transmissivity, dimensionless.
τ_a = transmissivity due to scattering by dry air molecules for unit air mass and for a barometric pressure of 760 mm of mercury, dimensionless.
τ_d = transmissivity due to scattering by dust particles for unit air mass and for 800 dust particles per cubic centimeter, dimensionless.
τ_o = transmissivity due to absorption by ozone for unit air mass and for 2.5 mm of ozone depth, dimensionless.
τ_s = total spectral transmissivity due to scattering, dimensionless.
τ_w = transmissivity due to scattering by water vapor molecules for unit air mass and for 20 mm of precipitable water, dimensionless.
τ_{wA} = transmissivity due to absorption by water vapor for unit air mass and for 20 mm of precipitable water, dimensionless.
Φ = angle of tilt from vertical position.

Fundamental Procedure

When the earth is at its mean distance from the sun, the solar radiation incident upon a surface normal to the sun's rays and at the outer limit of the earth's atmosphere is known as the solar constant. Johnson[3] has determined the solar constant to be 2.00 g-cal per (sq cm) (min) or 442.4 Btu per (hr) (sq ft) with a probable error of ± 2 percent.

As the solar beam passes through the atmosphere, it is split into 3 parts: (1) one part is turned aside notably by air molecules, water vapor molecules, and dust particles and scattered in all directions; (2) a second part is absorbed, chiefly by water vapor and ozone; and (3) the remainder passes through the atmosphere unchanged in wavelength.

The mechanisms of scattering and absorption by atmospheric constituents have been studied by many investigators. In a recent paper, Fritz[4] summarized the available knowledge and presented recommended procedures for calculating these effects.

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*Professor, Department of Mechanical Engineering, University of Minnesota. Member of ASHAE.

**Professor and Head, Department of Mechanical Engineering, University of Minnesota. Member of ASHAE.

[1]Exponent numerals refer to References.

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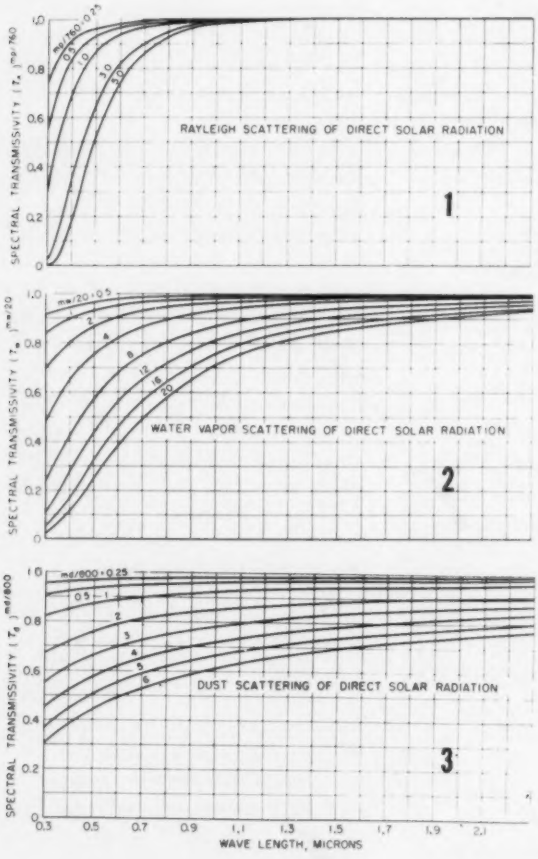
Journal Section

The fundamental method used here is largely an extension of Moon's[5] procedure using the best known available data. Moon correlated the individual transmissivity is known for unit air mass.

Fig. 1 shows the dry air scattering transmissivity $(\tau_a)^{mp/760}$ as a function of wavelength and the exponent mp/760. The curve for mp/760 equal to unity was presented by Fritz.[4] The other curves were calculated from the unity curve. It is significant to observe that the depletion effect of dry air or Rayleigh scattering is primarily at the shorter wavelengths and at high air masses it becomes pronounced.



Figs. 1, 2, 3 — Spectral fraction of direct solar radiation transmitted through atmosphere due to scattering; 1 is Rayleigh scattering at various barometric pressures and air masses; 2 is scattering at various depths of precipitable water and air masses; 3 is dust scattering at various concentrations of dust particles and air masses

Fig. 2 shows the water vapor scattering transmissivity $(\tau_w)^{mw/20}$ as a function of wavelength and the exponent mw/20. The unity curve for unit air mass and 20 mm of precipitable water was taken from Moon's[5] paper. Fig. 2 shows that for large values of the exponent mw/20, water vapor significantly reduces the direct solar beam by scattering. As compared to dry air scattering, water vapor scattering extends to much higher wavelengths.

Fig. 3 shows the dust scattering transmissivity $(\tau_d)^{md/800}$ as a function of wavelength and the exponent md/800. The unity curve for unit mass and 800 dust particles per cc was taken from Moon's[5] paper. Fig. 3 shows that dust scattering is less influenced by wavelength than are dry air and water vapor scattering.

Fig. 4 shows the ozone transmissivity $(\tau_o)^{mo/2.5}$ due to absorption of direct solar radiation as a function of wavelength and the exponent mo/2.5. The unity curve for unit air mass and 2.5 mm of ozone depth was calculated from Moon's data[5]. Fritz[4] has stated that 2.5 mm of ozone (NTP) is typical of middle latitudes and is concentrated mainly at elevations between 15 and 35 kilometers. Fig. 4 shows that ozone absorbs selectively, being strongly absorbing in the ultraviolet band and also depletes some radiation in the band of 0.43 to 0.70μ. In other bands

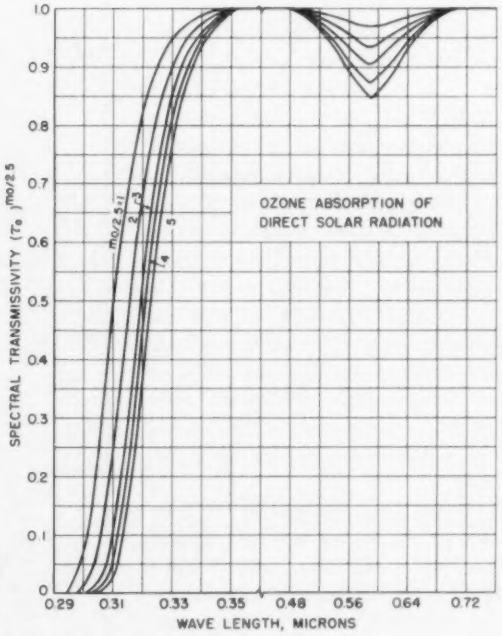


Fig. 4 — Spectral fraction of direct solar radiation transmitted through atmospheric ozone due to absorption for various air masses

work of several investigators on the spectral total effect of scattering by

$$\tau_s = [(\tau_a)^{p/760} (\tau_w)^{w/20} (\tau_d)^{d/800}]^m \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Moon also calculated transmissivities due to absorption by ozone and water vapor. By combining these transmissivities with Equation 1, the total spectral transmissivity is given by

$$\tau = (\tau_a)^{mp/760} (\tau_w)^{mw/20} (\tau_d)^{md/800} (\tau_o)^{mo/2.5} (\tau_{wA})^{mw/20} \quad \ldots\ldots (2)$$

The exponential constants of Equation 2 represent in each case the magnitude for which the respective

the transmissivity is unity. The exponential method of extension to other air masses was taken from Moon's[5] procedure.

Fig. 5 shows the water vapor transmissivity $(\tau_{wA})^{mw/20}$ due to absorption of direct solar radiation. The unity curve was calculated from Fowle's[6] data. A family of curves was constructed for various values of mw/20 using the same method as employed by Moon.[5] Only 2 curves are shown in Fig. 5 to avoid confusion of lines. The curve for mw/20 equals 15 represents an extreme condition. Fig. 5 shows the selective nature of water vapor absorption and indicates that in some broad bands in the infrared complete extinction occurs.

30, 60 mm; Dust particles = 0, 400, 800, per cc; Air mass = 1, 2, 3, 4, and 5.

In all, 60 sets of calculations were made. For each set, individual calculations for τ were made for 63 wavelengths in the range of 0.295 to

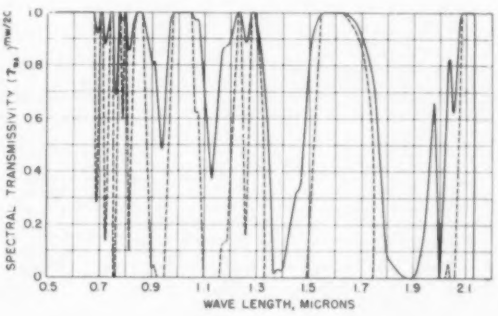
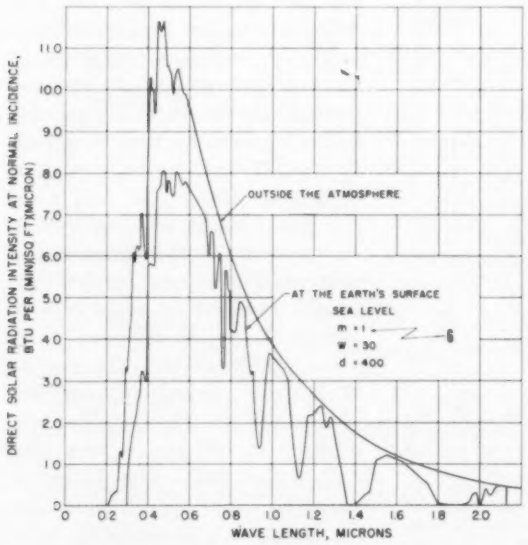
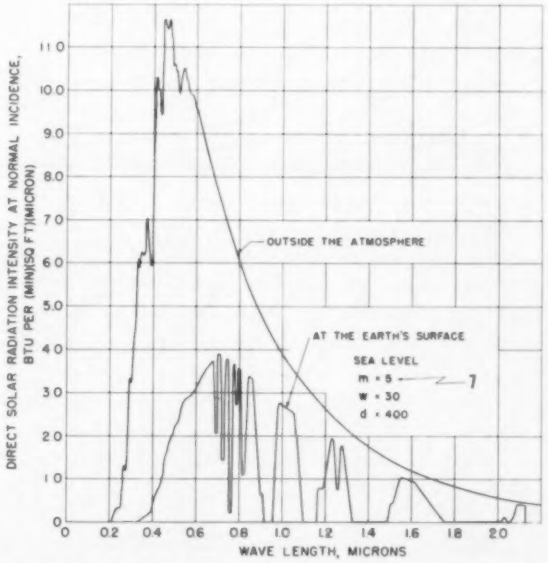


Fig. 5 — Spectral fraction of direct solar radiation transmitted through atmospheric water vapor due to absorption for various depths of precipitable water and air masses; with solid lines indicating mw/20 = 1.0; and broken lines mw/20 = 15.0





Figs. 6, 7 — Spectral distribution of direct solar radiation at normal incidence for the upper limit of the atmosphere and at the earth's surface for conditions at sea level, 30 mm of precipitable water, and 400 dust particles per cc; m = 1 at 6 and m = 5 at 7

With the fundamental data given by Figs. 1 through 5, total spectral transmissivities, τ, may be calculated by Equation 2 for various air masses and atmospheric conditions. At any wavelength, the total spectral transmissivity multiplied by the spectral radiation intensity outside the atmosphere gives the spectral direct radiation intensity at the earth's surface.

Complete calculations were carried out for the following conditions: Sea level; Ozone depth = 2.5 mm; Depth of precipitable water = 0, 10, 2.13 μ, thus giving sufficient points to construct accurately the energy curves at the earth's surface.

Fig. 6 shows the graphical results for one set of calculations where the conditions were 400 dust particles, 30 mm of precipitable water, and air mass of 1. The upper curve is the spectral energy distribution outside the atmosphere as given by Johnson.[3] The lower curve is the calculated energy distribution at sea level for the given conditions. The area under the upper curve is the solar constant or 442.4 Btu per (hr) (sq ft). The area under the lower curve as determined through use of a planimeter is 280.0 Btu per (hr) (sq ft). Thus the atmospheric transmission factor for the assumed conditions is 280.0/442.4 equals 0.633.

Fig. 7 shows the results for the same conditions as Fig. 6 except for air mass 5. For this case the transmission factor is 0.276. Fig. 6 represents the condition for the sun at the zenith (altitude angle of 90 deg) while Fig. 7 is for an altitude angle of approximately 11 deg. Thus the length of path of the sun's rays through the atmosphere is of extreme importance in affecting reduction of solar intensity.

Transmission Factors

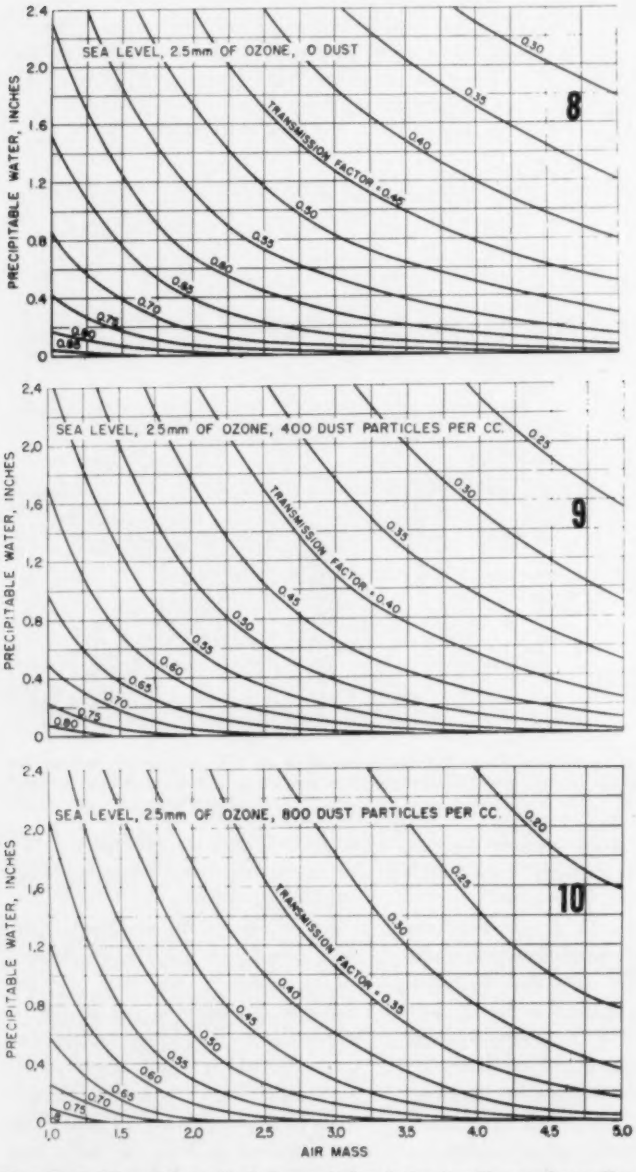
The calculations previously described allowed the calculation of atmospheric transmission factors for a wide variety of conditions. Figs. 8, 9, and 10 show the transmission factor for the atmosphere as a function of precipitable water and air mass for 0, 400, and 800 dust particles per cc, respectively. These figures show that during clear days the transmission factor at sea level for direct solar radiation at normal incidence may vary from about 0.85 down to less than 0.20 depending upon the air mass and atmospheric conditions.

It was found that for a given air mass and depth of precipitable water the transmission factor was closely a linear function of the number of dust particles. Fig. 11 shows the decrease of the transmission factor with increase of dust, with the decrease being greatest at low values of precipitable water and large values of air mass.

The effect of elevation upon the transmission factor was also investigated. Equation 2 and Fig. 1 show that with other conditions constant the total spectral transmissivity increases as the barometric pressure decreases. Thus, one would expect the transmission factor to increase for surfaces above sea level.

A set of calculations were made for 1000 ft elevation, 2.5 mm of ozone, 30 mm of precipitable water, 400 dust particles per cc, and for 5 air mass values. Transmission factors were determined and were found to differ from the sea level transmission factor for the same condition by about one percent. Thus for ordinary purposes the sea level transmission factors as given by Figs. 8 through 11 are sufficiently accurate at elevations up to 1000 ft.

A more complete set of calculations were made for 5000-ft elevation. Calculations by the same method previously described for sea level were carried out for the following conditions: 5000 ft elevation; Ozone depth = 2.5 mm; Depth of precipitable water = 0, 10, 30 mm; Dust particles = 0, 400 per cc; Air mass = 1, 2, 3, 4 and 5. Figs. 12 and 13 show the results of the calculations for atmospheric transmission factor for direct solar radiation at normal incidence as a function of precipitable water and air mass for 0 and 400 dust particles per cc, respectively. Detailed comparisons between the sea level calculations and those for 5000-ft elevation showed that, for other conditions the same, the transmission factors generally agreed within about 3 percent. For example, at air mass 5 and 400 dust particles per cc, the sea level transmission factor differed from that at 5000 ft by 1.4 percent for zero precipitable water, 2.2 percent at 10 mm precipitable water, and 2.9 percent at 30 mm precipitable water. Thus, even at elevations up to 5000 ft the sea level


SEA LEVEL, 2.5mm OF OZONE, 0 DUST
8
TRANSMISSION FACTOR = 0.45
SEA LEVEL, 2.5mm OF OZONE, 400 DUST PARTICLES PER CC.
9
TRANSMISSION FACTOR = 0.40
SEA LEVEL, 2.5mm OF OZONE, 800 DUST PARTICLES PER CC.
10
TRANSMISSION FACTOR = 0.35
PRECIPITABLE WATER, INCHES
AIR MASS

Figs. 8, 9, 10 — Atmospheric transmission factor for direct solar radiation at normal incidence for sea level, 2.5 mm of ozone, and various dust particles as a function of precipitable water and air mass; with zero dust at 8; 400 dust particles per cc at 9; 800 dust particles at 10

transmission factors are reasonably accurate. This finding is in disagreement with conclusions previously published by others who attributed an increase of 15 percent or more to the effect of an elevation of 5000 ft. The primary reasons for a generally substantial increase of incident radiation at locations at high elevation are the lower depths of precipitable water in the atmosphere, which is characteristic of the Rocky Mountain states, and the relatively dust-free atmospheres of such localities.

For elevations between 1000 and 5000 ft, linear interpolation between Figs. 8 and 12 and between Figs. 9 and 13 should provide a close estimate of the transmission factor.

It is also of interest to estimate the irradiation of a surface by direct solar radiation at various positions in the atmosphere. Since atmospheric water vapor and dust are primarily concentrated within a few thousand feet of the earth's surface, it is reasonable to assume that at higher location in the atmosphere, depletion of direct solar radiation occurs primarily by dry air scattering and by ozone absorption.

Fig. 14 shows the distribution of 2.5 mm of ozone (NTP) as a function of elevation. Fig. 14 was calculated from data given by Gotz, Meetham, and Dobson.[7]

Calculations were carried out for finding the transmission factor at various positions in the atmosphere assuming no dust and no water vapor and thus based upon depletion by dry air scattering and ozone absorption only. Ozone depths above a given elevation were taken from Fig. 14. The results of the calculations are shown by Fig. 15 which shows the transmission factor as a function of elevation and air mass.

Application of Transmission Factors

Before the direct irradiation of a surface at a specific locality and time may be estimated, the sun's position relative to the earth must be known. The sun's position is established by its declination, altitude, and azimuth angles. The sun's declination which is the angular distance of the sun north or south of the celestial equator is given in *The American Nautical Almanac*.[8] With the declination known, the sun's altitude and azimuth are given in U. S. Hydrographic Office Tables 214.[9] These angles may also be found with less exactness from other sources.[10]

The term *air mass* as used throughout this paper is the optical value and is the ratio of the actual length of path of the sun's rays through the atmosphere to the length of path vertically above the surface in question. At air mass 1, the sun is at the zenith. As used here the air mass is independent of position above sea level. Except at very low elevations of the sun, the air mass is equal to the cosecant of the altitude angle. At low elevations, corrections may be made by Bemporad's relation.[11] Fig. 16 shows the relationship between air mass and the sun's altitude angle.

The solar constant is variable because of the changing distance between the earth and the sun due to the earth's orbit being slightly elliptical, with the sun located off-center of the ellipse. Fig. 17 shows the factor to be multiplied by the solar constant to give radiation intensity at normal incidence at the outer limit of the atmosphere. Fig. 17 is based upon Fowle's data.[12]

Weather Bureau Technical Paper No. 10[13] presents information on mean precipitable water for the United States. Although based on an average of only about 4 years of

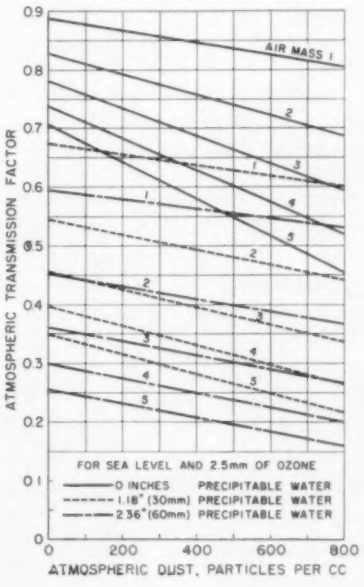
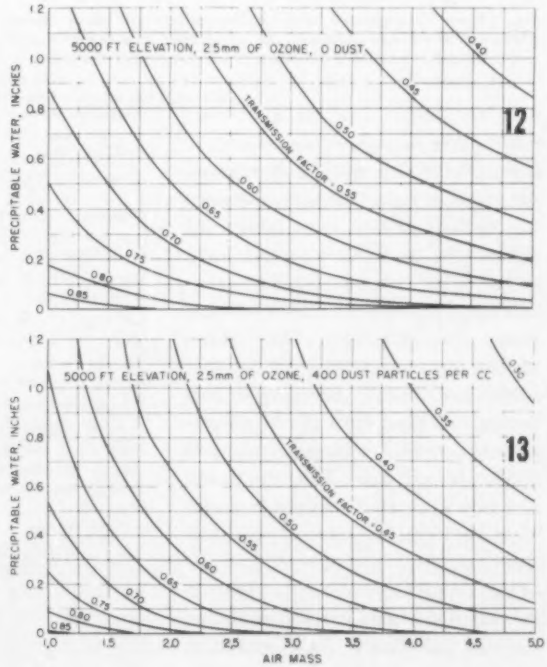


Fig. 11 *(above)* — Atmospheric transmission factor for direct solar radiation at normal incidence for sea level and 2.5 mm of ozone as a function of dust particles, precipitable water, and air mass


5000 FT ELEVATION, 2.5mm OF OZONE, 0 DUST
TRANSMISSION FACTOR = 0.55
PRECIPITABLE WATER, INCHES
12
5000 FT ELEVATION, 2.5mm OF OZONE, 400 DUST PARTICLES PER CC
TRANSMISSION FACTOR = 0.65
13
AIR MASS

Figs. 12, 13 — Atmospheric transmission factor for direct solar radiation at normal incidence for 5000 ft elevation, 2.5 mm of ozone, and various dust concentrations as a function of precipitable water and air mass; with zero dust at 12; 400 dust particles per cc at 13

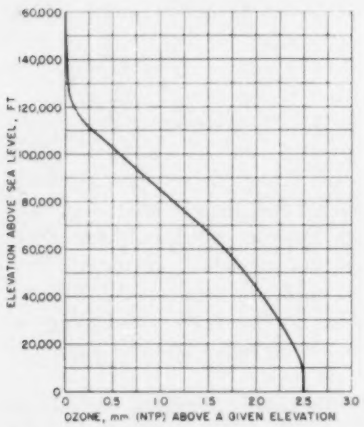


Fig. 14 — Distribution of 2.5 mm of atmospheric ozone (NTP) as a function of elevation above sea level

at normal incidence is known. Fig. 22 defines the angles used in the following equations.

For a surface tilted from the vertical position by an angle, φ the intensity of incident direct solar radiation is given by

$$I_{TV} = I_N (\sin \beta \sin \phi + \cos \beta \cos \alpha \cos \phi) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

If the surface is vertical ($\varphi = 0$),

$$I_v = I_N \cos \beta \cos \alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

If the surface is horizontal ($\varphi = 90$ deg),

$$I_H = I_N \sin \beta \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Several examples will now be shown to illustrate use of the information given previously.

Example 1: Based upon average conditions, estimate the incidence of direct solar radiation upon a south-facing surface tilted by 40 deg from the vertical position at Albuquerque, N. Mex., for 11:00 a.m. sun time on a clear July 15.

Solution: It will be assumed that Albuquerque is a relatively dust-free location with 200 dust particles per cc. By Fig. 20, $w = 0.95$ in. For clear days, $w = (0.85)\ (0.95) = 0.81$ in. By Reference 9, $\beta^* = 71^\circ\ 09'$, $\gamma = 131.8^\circ$; thus $\alpha = 48.2^\circ$ for a south-facing surface. By Fig. 16, air mass = 1.07. Since the elevation above sea level at Albuquerque is 5314 ft, the transmission factor charts for 5000 ft will be used. By Fig. 12 ($d = 0$, $w = 0.81$, $m = 1.07$), $TF = 0.70$. By Fig. 13 ($d = 400$, $w = 0.81$, $m = 1.07$), $TF = 0.66$; thus, $TF = 0.68$ for $d = 200$. By Fig. 17, $I_o/I_{sc} = 0.968$; and thus, $I_N = (0.68)\ (0.968)\ (442.4) = 291$ Btu per (hr) (sq ft). By Equation 3, $I_{TV} = 291\ [(0.946)\ (0.643) + (0.323)\ (0.667)\ (0.766)] = 225$ Btu per (hr) (sq ft).

*For meaning of β, γ and α see Fig. 22.

Example 2: Based upon average conditions, estimate the incidence of direct solar radiation upon an east-facing vertical wall at Lincoln, Nebr., for 11:00 a.m. sun time on a clear July 15.

Solution: As for Albuquerque, Lincoln will be assumed to have 200 dust particles per cc. By Fig. 20, $w = 1.32$ in. For clear days, $w = (0.85)\ (1.32) = 1.12$ in. By Reference 9, $\beta = 66^\circ\ 44'$, $\gamma = 142.4^\circ$; thus $\alpha = 52.4^\circ$ for an east-facing surface. By Fig. 16, air mass = 1.1. Since the elevation above sea level at Lincoln is 1250 ft, the transmission charts at sea level should be sufficiently accurate. By Fig. 8 ($d = 0$, $w = 1.12$, $m = 1.1$), $TF = 0.67$. By Fig. 9 ($d = 400$, $w = 1.12$, $m = 1.1$), $TF = 0.62$; thus $TF = 0.645$ for $d = 200$. $I_N = (0.645)\ (0.968)\ (442.4) = 276$ Btu per (hr) (sq ft). By Equation 4, $I_v = (276)\ (0.395)\ (0.610) = 67$ Btu per (hr) (sq ft).

Example 3: Estimate the incidence of direct solar radiation upon a horizontal surface of an airplane flying at 50,000 ft altitude over Lincoln, Nebr., at 11:00 a.m. on July 15.

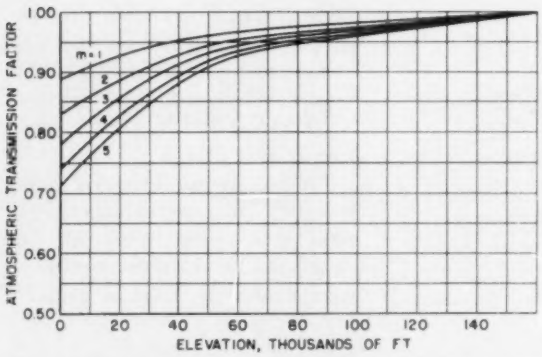


Fig. 13 — Atmospheric transmission factor for direct solar radiation at normal incidence for a dustless and water vapor free atmosphere as a function of air mass and elevation

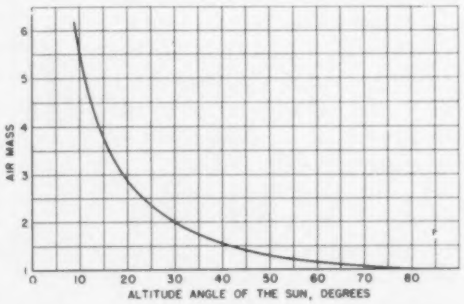


Fig. 16 — Relationship between air mass and altitude angle of the sun

data per station, it is the most complete source of information available. Figs. 18, 19, 20, and 21 show mean precipitable water in inches between the surface and 8 km altitude for the months of January, April, July, and October, respectively. These figures were reproduced from *Technical Paper No. 10*.[13] The values shown are means for all types of weather conditions. Fritz[14] has shown that during cloudless days the mean precipitable water is approximately 0.85 of that for all days. Thus the values given by Figs. 18-21 should be multiplied by 0.85 for clear-day calculations.

The irradiation of any surface on the earth by direct solar radiation may be calculated if the radiation

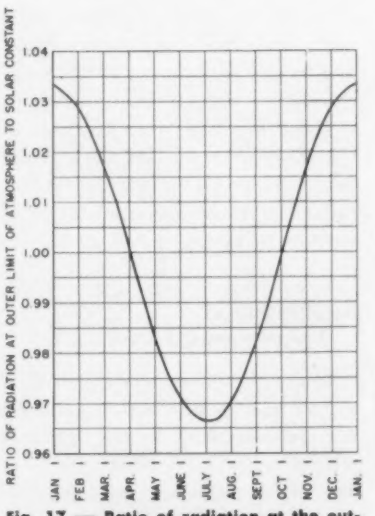


Fig. 17 — Ratio of radiation at the outer limit of the atmosphere to the solar constant as a function of time of year

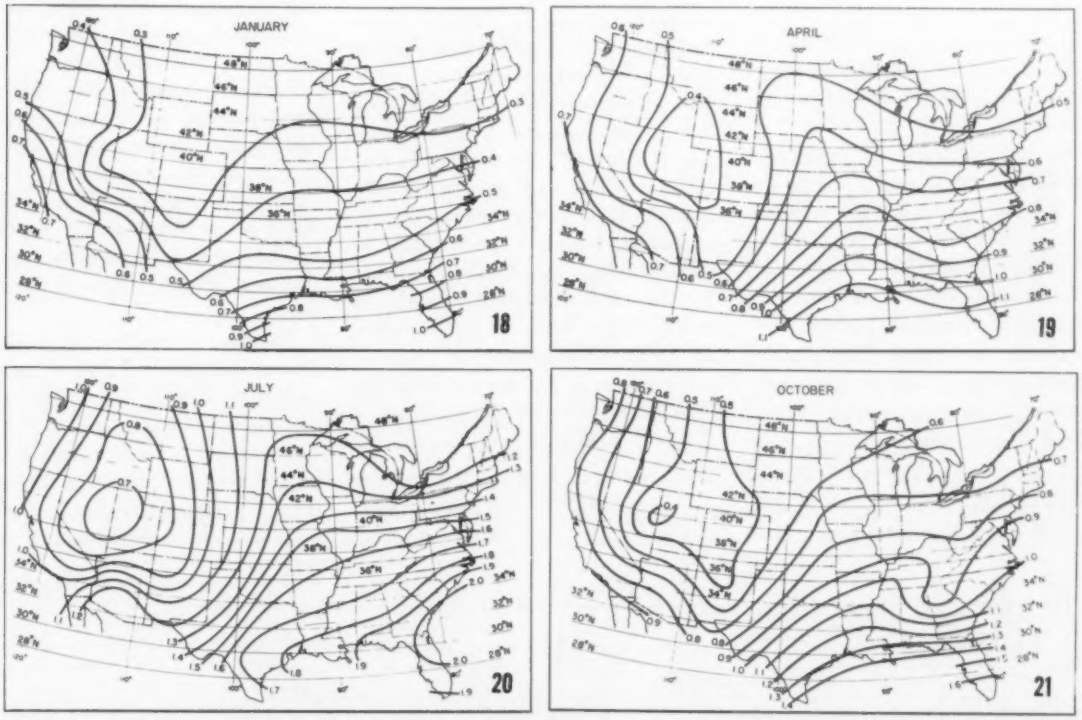
Solution: By Example 2: $\beta = 66° 44'$, air mass = 1.1. By Fig. 15, $TF = 0.96$. $I_N = (0.96)\ (0.968)\ (442.4) = 411$ Btu per (hr) (sq ft). By Equation 5, $I_H = (411)\ (0.919) = 377$ Btu per (hr) (sq ft).

Comparison of Calculated and Observed Direct Solar Radiation

The U.S. Weather Bureau has made regular observations of direct solar radiation at normal incidence during clear days at several localities for many years. Hand[15] has described the methods used at the various stations.

Comparisons were made between calculated radiation using the mean precipitable water as 0.85 of the value given by *Technical Paper No. 10*[13] with the sea level transmission factors as given by this paper with correction to the actual solar distance and the mean observed radiation for several stations as published in *Climatological Data, National Summary*.

Figs. 23, 24, 25, and 26, show comparisons for air masses 2 and 4 for Blue Hill, Lincoln, Madison, and Washington, D.C., respectively. The observed radiation is shown for the 15th of each month only. These figures show that for Blue Hill, Lincoln, and Madison, the calculated radiation compares quite favorably if a dust concentration of about 200 particles per cc. is assumed. However, in interpreting this concentration, it should be recognized that this number is essentially a dust or a turbidity index rather than an absolute concentration since the actual numbers of particles per unit volume are usually defined in relative rather than absolute terms and are dependent upon the efficiency of the collecting device, the magnification and type of illumination employed and similar factors. In this case a dust particle concentration or index number of 200 represents a relatively uncontaminated atmosphere.



Figs. 18, 19, 20, 21 — Mean precipitable water in the United States for: January at 18; April at 19; July at 20; October at 21; (based on maps shown in Weather Bureau Technical Paper No. 10)

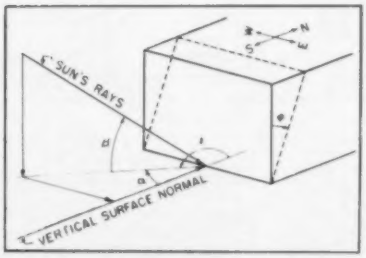


Fig. 22 — Definition of solar angles. α = wall solar azimuth angle; β = solar altitude angle; γ = solar azimuth angle; Φ = angle of tilt from vertical position

On the other hand, Fig. 26 shows that for the dust scale used in this paper, Washington, D.C., appeared to have on the average a dust concentration or index number somewhat higher than 400 particles per cc during the winter and spring seasons. Seasonally high dust concentrations are frequently experienced in the winter and spring periods because of the large volumes of particulate matter ejected into the atmosphere by heating plants during these seasons. Therefore, these results are not un-

expected, particularly in view of the fact that these data were averaged over a period of years when coal-burning heating plants were more prevalent than at the present time. A similar analysis was attempted for Boston, Mass. Available observed data were insufficient to permit an adequate comparison, but for the data available correlation with calculated radiation occurred with a dust index or concentration of 400 to 600 particles per cc.

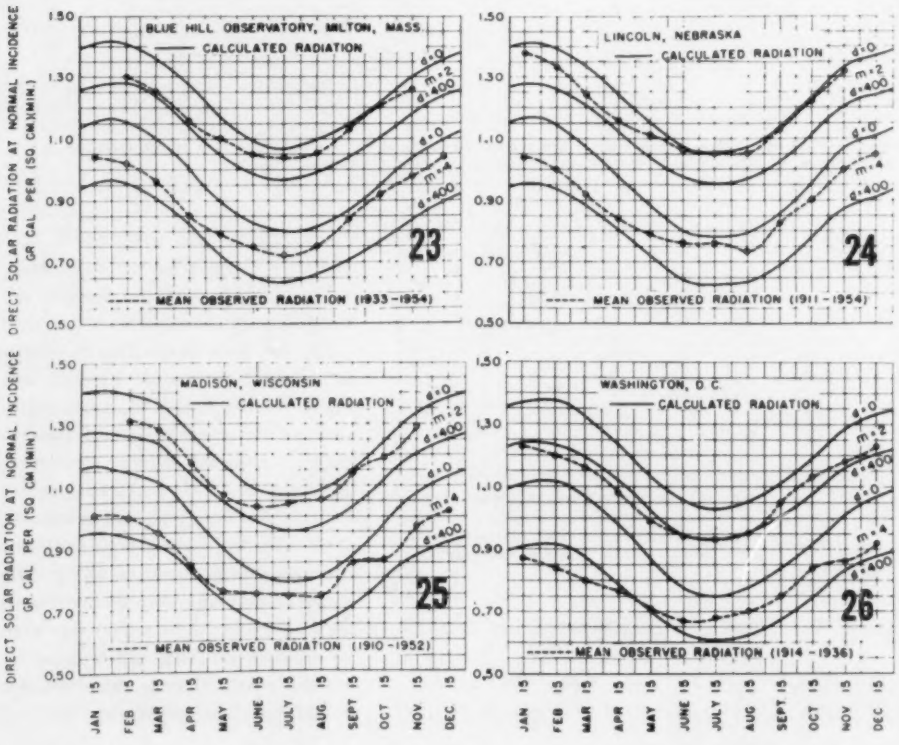
The authors believe that the calculation method given in this paper is a reliable procedure for estimating incidence of direct solar radiation. If the atmospheric conditions of dust and water vapor are known, the direct irradiation of a surface may be closely estimated. Precipitable water depth and dust content may vary widely from day to day. As indicated earlier, the estimation of the dust content is the most difficult part of the calculation procedure. An inspection of Equation 2 shows that dust is assumed as the only atmospheric contaminant, but actually since atmospheric dust is less well defined and evaluated than the other factors involved in the equation, it may include not only the dust turbidity factor but any other neglected factors which may have a small effect upon the transmissivity. Predominantly, however, the factor involves atmospheric cleanliness. A concentration or index of 200 particles per cc should represent a rather clean atmosphere while 800 particles per cc should represent essentially an industrial atmosphere. There is a need for more research on quantitative evaluation of this dust index number in various localities and concurrent observations of direct solar radiation at normal incidence, particularly in industrial localities. While, fortunately, this dust factor has usually a smaller effect upon the transmission factor than the quantity of precipitable water in the atmosphere, further research would permit a more accurate evaluation of the dust index number as used here and would allow extension of the calculation procedure.

Approximate Procedure

The transmission factor method previously described requires knowledge of several quantities before the irradiation of a surface may be estimated. In addition, considerable calculation and use of separate charts are required. It is possible to devise an approximate procedure which allows much more rapid calculation and which is still sufficiently accurate for many engineering problems.

It has been shown previously that the sea level transmission factor charts are generally applicable to most parts of the United States and that a dust index of 200 particles per cc appears typical for a non-industrial atmosphere. Thus, precipitable water depth is the important variable with seasons of the year and between different parts of the country.

In order to simplify the procedure, it was decided to define a basic atmosphere at a sea level location consisting of 2.5 mm of ozone, 200 dust particles per cc and a varying precipitable water depth as given by Fig. 27. This figure was constructed so as to make the calculated direct



Figs. 23, 24, 25, 26 — Comparison of calculated and mean observed direct solar radiation at: Blue Hill Observatory at 23; Lincoln, Nebr., at 24; Madison, Wis., at 25; Washington, D.C., at 26

solar radiation values closely correspond with the mean observed values at Blue Hill, Lincoln, and Madison throughout the year.

Calculations were then made using appropriate transmission factors for this basic atmosphere for north latitudes of 30, 36, 42, and 48 deg. The results of the calculations are shown in Figs. 28, 29, 30, and 31. These figures show direct solar radiation at normal incidence in Btu per (hour) (square foot) for various daylight hours throughout the year. It is interesting to observe that except at relatively early morning and late afternoon hours, maximum radiation at normal incidence occurs in March and April throughout the country.

It is proposed that Figs. 28-31 be considered as standard curves and that the basic atmosphere for which they were constructed be considered as having an atmospheric clearness number of unity. These curves may then be used for any locality by multiplying values from them by the atmospheric clearness number of the location.

Fig 32 shows atmospheric clearness numbers for Madison, Lincoln, Blue Hill, and Albuquerque found by dividing the mean observed radiation at normal incidence by that calculated for the basic atmosphere for air mass 1(β = 90 deg), air mass 2(β = 30 deg), and air mass 3(β = 19 deg). Fig. 32 shows that Madison, Lincoln, and Blue Hill have clearness numbers close to unity throughout the year with little scatter due to optical air mass. However, Fig. 32 shows that at Albuquerque, the clearness number varies considerably throughout the year and that there is a considerable scatter with optical air mass. Variation of the clearness number with time of year at Albuquerque is primarily due to the nonproportional variation of precipitable water as compared to Fig. 27.

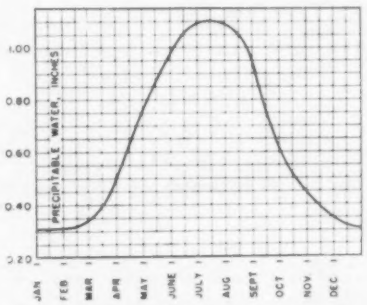
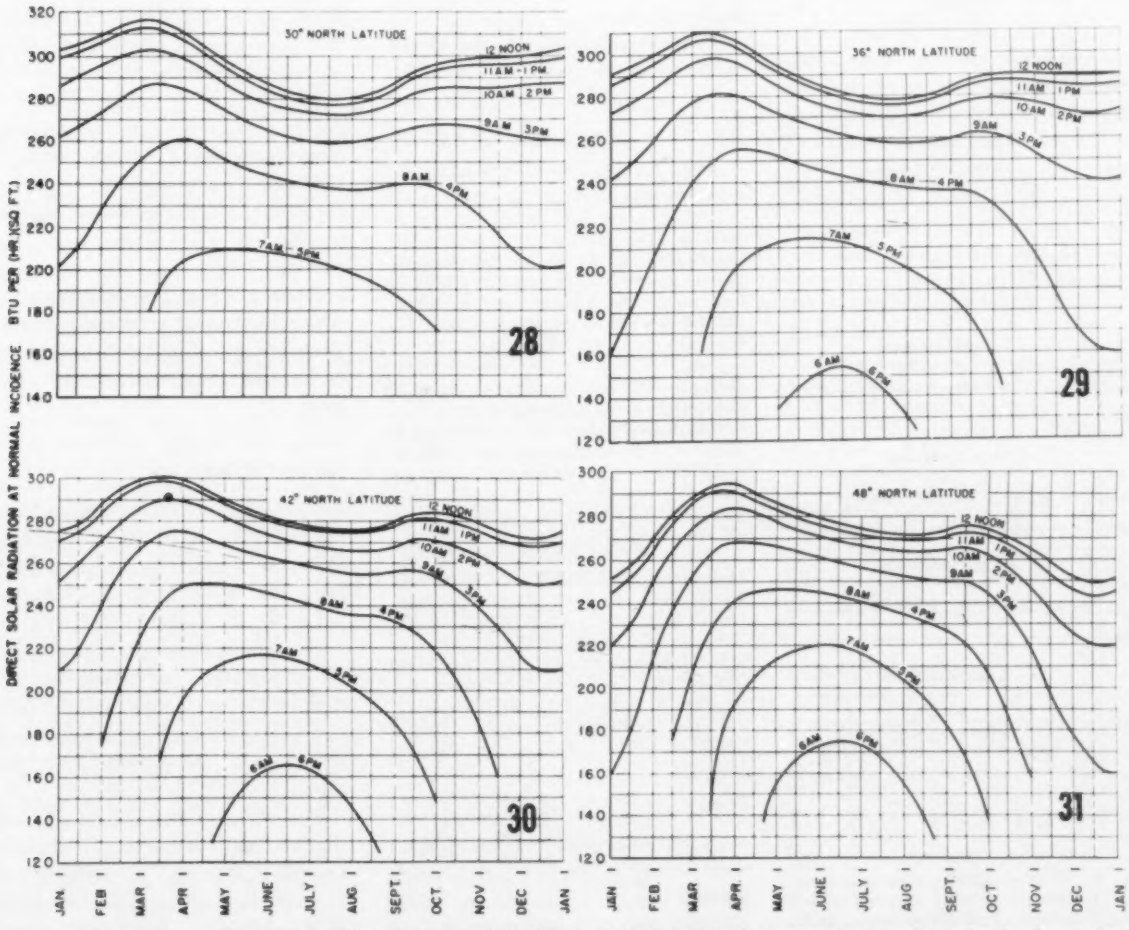


Fig. 27 — Precipitable water variation for basic atmosphere



Figs. 28, 29, 30, 31 — Direct solar radiation at normal incidence with the atmospheric clearness number of unity for various north latitudes: 30 deg at 28; 36 deg at 29; 42 deg at 30; 48 deg at 31

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Several calculations for atmospheric clearness number were made for various localities where recorded radiation was not available by dividing the calculated radiation based upon clear-day precipitable water for the locality by the calculated radiation for the basic atmosphere. These calculations together with Fig. 32 were used in constructing Fig. 33.

Fig. 33 shows a broad estimate based on average conditions of the probable atmospheric clearness number in the United States. This map applies only to relatively clean atmospheres as in suburban and rural localities. In the eastern half of the country, except on the Gulf Coast, the same clearness number applies throughout the year. For the Gulf Coast, Rocky Mountain, and Pacific Coast regions, the atmospheric clearness number is lower in winter. This situation results because of the nonproportional character of seasonal precipitable water variation for these localities as compared to Fig. 27 for the basic atmosphere. In the southeastern states, atmospheric clearness numbers less than unity result because of relatively high concentrations of atmospheric water vapor. In the Rocky Mountain states, atmospheric clearness numbers greater than unity occur because of relatively low water vapor concentrations and higher altitudes.

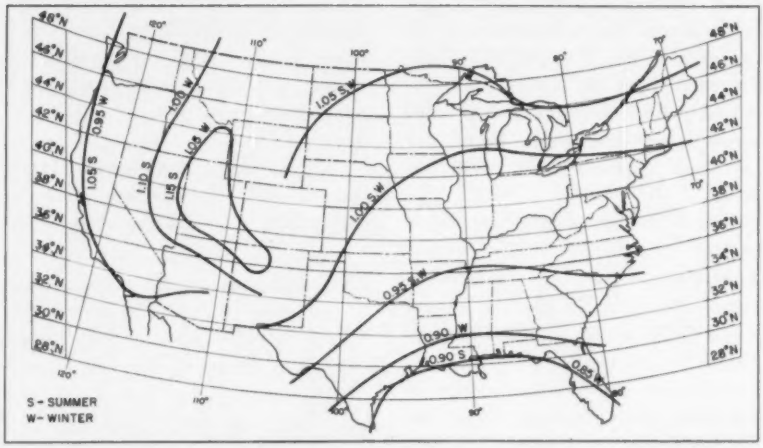

Fig. 33 — Estimated atmospheric clearness numbers in the U.S. for non-industrial localities

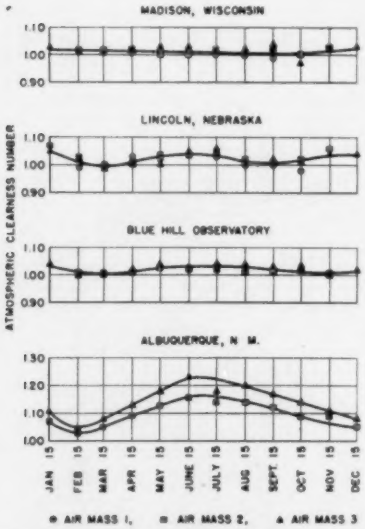
MADISON, WISCONSIN
LINCOLN, NEBRASKA
BLUE HILL OBSERVATORY
ALBUQUERQUE, N. M.
ATMOSPHERIC CLEARNESS NUMBER
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
AIR MASS 1, AIR MASS 2, AIR MASS 3

Fig. 32 — Atmospheric clearness numbers for Madison, Wis.; Lincoln, Nebr.; Blue Hill, Mass.; and Albuquerque, N.M., as calculated from mean values of observed radiation

Two examples will now be shown to illustrate the use of the radiation curves for the basic atmosphere and Fig. 33.

Example 4: *Rework Example* 2 *by approximate procedure.*

Solution: The latitude at Lincoln is 40° 49′. By Fig. 30, I_N = 276 Btu per (hr) (sq ft) for basic atmosphere. By Fig. 33, *C.N.* = 1.0. By Equation 4. I_T = (276) (0.395) (0.610) = 67 Btu per (hr) (sq ft).

Example 5: *Based upon average conditions compare the incidence of direct solar radiation upon a flat roof of a building in suburban Minneapolis with one in Dallas at* 12:00 *noon sun time on a clear July* 1*st.*

Solution: For Minneapolis: Latitude = 45°. By interpolation between Figs. 30 and 31, I_N = 277 Btu per (hr) (sq ft) for basic atmosphere. By Fig. 33, *C.N.* = 1.02. By Reference 9, β = 68° 10′. By Equation 5, I_H = (1.02) (277) (0.928) = 262 Btu per (hr) (sq ft).

For Dallas: Latitude = 33°, I_N = 280 Btu per (hr) (sq ft) for basic atmosphere. By Fig. 33, *C.N.* = 0.95. By Reference 9, β = 80° 10′. By Equation 5, I_H = (0.95) (280) (0.985) = 262 Btu per (hr) (sq ft).

Thus the direct radiation is the same for each locality. The approximate nature of the clearness number method of calculation and its limitation to broad estimates of direct solar radiation during clear days for relatively clean atmospheres should be recognized. For industrial localities, the atmospheric clearness number is less than that given by Fig. 33. As stated earlier, there is a need for more experimental observations of direct solar radiation, particularly in industrial localities. Any such observations may be immediately expressed in terms of atmospheric clearness numbers for the locality. Thus the clearness number concept appears to be a convenient way of correlating experimental data. The authors believe that this approach provides a simple and reasonably accurate method of estimating for engineering purposes the incidence of direct solar radiation during clear days.

Acknowledgments

The authors wish to acknowledge the assistance of Harrison Benjamin, graduate research assistant, Department of Mechanical Engineering, University of Minnesota, during the research which resulted in this paper. Mr. Benjamin was responsible for most of the calculations and in addition contributed many original ideas which were incorporated into the paper.

The authors also wish to acknowledge the assistance of R. H. Hanson, research assistant, Department of Mechanical Engineering, University of Minnesota, who made many of the calculations.

In addition, the authors wish to express their appreciation to the National Science Foundation which provided the financial support for the research.

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EJC STATES POLICY ON AIR POLLUTION

For some time, an *EJC* Committee has been at work on drawing up a policy statement on air pollution and its control.

P. J. Marschall, Chicago, Ill., is the ASHAE representative on this Committee.

The Board of Directors of *EJC* approved the statement at its meeting in September and the statement is available in printed form under the title *Engineers Joint Council Policy Statement on Air Pollution and Its Control*. Free copies of the printed statement are available on request.

GRANT RECEIVES NEW ASSIGNMENT

J. F. Downie Smith has been elected a vice president of Carrier Corporation and will head its central Research and Development Division. Walter A. Grant, a member of the Society's Council and vice president of Carrier Corporation since 1953, has been designated as coordinator of all development engineering activities. The appointments of both Dr. Smith and Mr. Grant will become effective January 1.

For the past 10 years Dr. Smith has been dean of engineering at Iowa State College. He also has served as director of its Engineering Experiment Station and Engineering Extension Service. Under his leadership the research program of the Engineering Experiment Station has become more extensive. Projects include the use of ultrasonics, network analyzers, digital computers, utilization of various agricultural by-products, TV signal recording, nuclear engineering problems and X-ray diffraction studies.

Mr. Grant joined Carrier in 1928 and is an outstanding authority in the field of air-conditioning engineering, especially application and development. He studied at Amherst College and Columbia University and has both science and engineering degrees. With the late Willis H. Carrier, he is co-author of one of the most widely used textbooks on air conditioning and has had published a number of technical papers. He has been responsible for many advances in the fields of aerothermodynamics, absorption refrigeration and heat transfer. He has been a member of the Society since 1929.

PROGRAM FOR 1958 NUCLEAR CONGRESS

The program committee of the Nuclear Engineering and Science Conference, which is being held as a part of the 1958 Nuclear Congress in Chicago, March 17-21, 1958, announces that the program will consist of some 200 papers.

It is expected that they will be presented during the course of 25 technical sessions. The program for the Nuclear Congress is being coordinated by *Engineers Joint Council*, of which the Society is a member. The Society representative on the program committee is H. A. Lockhart, Morton Grove, Ill.

THERMODYNAMICS FOR CHEMICAL ENGINEERS

The second edition of the well-known book by Professors Weber and Meissner of Massachusetts Institute of Technology has recently been published. The book gives a comprehensive coverage of the principles and applications of thermodynamics from the viewpoint of both the engineer and the chemist.

Since the book is prepared for both the engineer and the chemist, this broader point of view makes possible translation of findings from chemical laboratories into the economical production methods of the modern industrial plant.

The second edition includes an expanded treatment of fluid flow, plus descriptive chapters on power cycles, engines, turbines, and refrigerators. Most of the new material has been tested in chemical engineering courses at MIT during the past two years. The presentation followed has been adopted after a considerable period of experimentation.

Many illustrative examples with solutions, and many new problems make the book more useful than ever before. All the problems and study aids are designed to make the reader *think* rather than calculate. The authors stress the approximate methods of solution where complete data are lacking. [*Thermodynamics for Chemical Engineers*, by H. C. Weber and H. P. Meissner, second edition, John Wiley & Sons, Inc., New York, 6 × 9 in., $8.50].

NEW EDITION OF HEAT TRANSFER

The third edition of the book by Jakob and Hawkins on *Heat Transfer* is intended to present fundamental concepts in the field. It begins by presenting the fundamental modes of heat transfer, followed by a combination of two or more modes. Easy-to-follow examples are given after the introduction of new subjects.

[*Elements of Heat Transfer*, by Max Jakob and G. A. Hawkins, third edition, John Wiley & Sons, Inc., New York, 6 × 9 in., $6.75].

DUBRY RETIREMENT ANNOUNCED

E. E. Dubry, general superintendent, central heating department, The Detroit Edison Co., retired after 43 years with the company. Thirty-eight of these years were with the central heating department, where he has been superintendent since 1945. He received the title of general superintendent in 1952.

Mr. Dubry, a Life Member, joined the Society in 1924. In 1930, he served the Michigan Chapter as its president, after a year as vice president.

Laboratory Sound Study Program

By W. F. Kerka*, Cleveland, Ohio

The sound study program at the ASHAE Laboratory is a timely one. It is aimed at developing specific information which when fully completed will permit air-conditioning installations to operate without exceeding noise levels considered desirable. Noise control is a refinement in air conditioning greatly to be desired under present circumstances.

Fan Noise Study

One important phase of the Laboratory program is the subject of fan noise. In an air-conditioning system, the noise source is commonly an air-moving device, and the path may be the duct system coupling the air-moving device (fan) to the conditioned space. For effective noise control, the acoustic characteristics of the duct system and the noise output of the fan must be known or readily measured.

In the past, the test codes used for rating the noise output of fans were based upon overall sound levels only, with little regard to the frequency distribution of their sound spectrum. Experience has shown that frequency distribution is important not only from the standpoint of loudness and annoyance, but in choosing the type and method of acoustic treatment needed to reduce noise levels.

In the fan-noise program at the ASHAE Research Laboratory, 4 methods of determining the acoustic power output of a fan by octave-band analysis were investigated. The information gained from the program is suitable for incorporation into a standard for measuring the sound output of air-conditioning equipment. A joint committee for preparing such a standard has been formed by the *American Society of Refrigerating Engineers* and the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS.

Methods of Acoustic Measurement

Another phase of the sound program at the Laboratory has been concerned with a study of how acoustic measurements can best be made.

It has been found that, because of the diverse types of air-conditioning equipment, no one method of acoustic measurement can be used to cover all forms of apparatus.

For air-moving devices alone, several methods have to be employed. In the case of unit heaters, for example, it was found that the reverberant-room method can conveniently be used. In this method, the noise source is placed in a reverberant space, and sound-level measurements are made in the reverberant field surrounding the source. Where equipment becomes large compared to available indoor spaces, it may be necessary to use the free-field method. In this case, the noise source is placed in an unobstructed outdoor space, and the acoustic output is found from measurements made on a hypothetical surface around the source. Anechoic chambers are also used to represent this free-field or completely sound-absorbing environment.

Where a fan is coupled to a duct system, not only is the acoustic power radiated from the fan housing and motor of importance, but one would also want to know the amount of acoustic power delivered to the inlet and discharge ducts. While the reverberant-room method could be employed to determine the noise radiated from the fan housing, the acoustic power delivered to the duct system can be found through measurements made within the duct, using a non-reflecting termination at the end to absorb the acoustic power generated by the fan.

Duct System Noise

A third phase of the sound program has to do with generation and attenuation of sound in ducts. Through the sponsorship of the U. S. Navy, Bureau of Ships, the Laboratory is currently working on a program to investigate certain of these problems. Attention will first be directed toward the study of elbows. Besides the effect of duct length between elbows in series on noise attenuation and generation, the effect of elbow size, angle, and aspect ratio will be considered. Noise generation studies will be made at velocities ranging from 2000 to 5000 fpm with duct sizes ranging from 6 x 6 in. to 18 x 18 in. Studies will also be made on round ducts.

As a future phase the study of sound transmission through duct walls, noise attenuation of lined and unlined ducts, and the generation and attenuation of sound at branch takeoffs is contemplated.

*Research Engineer, ASHAE Research Laboratory.

A Dynamic Heat Storage System

By T. L. Etherington*, Schenectady, N. Y.

SUMMARY—A dynamic heat storage system using the latent heat of fusion of disodium phosphate dodecahydrate is described. A light mineral oil, mutually insoluble with aqueous disodium phosphate, was pumped through the salt to provide agitation and direct contact heat exchange. Excellent heat transfer with minimum undercooling resulted. The amount of latent heat stored and released varied with the unpredictable crystallization mechanism of the salt.

Widespread use of air-source heat pumps is dependent upon favorable electric power rates as determined by the cost to serve this load. Large amounts of electrical energy cannot be stored like combustible fuels and, therefore, a large intermittently operated load such as the heat pump becomes, under certain climatic and application conditions, an expensive load to serve.

The capacity (and electrical demand) of the air-source heat pump is greatest when its heat requirement is least and vice versa. Therefore, it is conceivable that its excess heat could be stored during low heat demand periods for use during high demand periods. The result would be a smaller unit (reduced electrical load) approaching continuous operation. This would constitute a more desirable load to serve, and should result in reduced rates for electrical service.

The general requirements for a heat storage system are low cost, reliability, safety and compactness. The compactness requirement indicates that storage as latent rather than sensible heat is preferable.

A disodium phosphate-water system has undergone considerable evaluation as an attractive possibility for heat storage due to its cheapness and the relatively high heat of fusion of the dodecahydrate ($Na_2HPO_4.12H_2O$). Its melting point of 96 F would also permit heat pumps to store their excess capacity during periods of low demand.

Unfortunately disodium phosphate does not always crystallize as the dodecahydrate (or 12-hydrate), but may form a heptahydrate which has a much lower heat of fusion. Previous investigators have attempted to eliminate formation of the $Na_2HPO_4.7H_2O$ (heptahydrate or 7-hydrate) phase by high temperature treatment to destroy seed crystals of the 7-hydrate, followed by rapid quenching to make the system metastable with respect to the heptahydrate[1]. Subsequent melting and freezing cycles have always been found to result finally in the formation of some of the 7-hydrate and reduced effectiveness of the storage salt.

The usual method of application has been to enclose the heat storage salt in a sealed container around which a heat exchange fluid is circulated[2]. This technique has several disadvantages. For example, during freezing (release of stored energy) the heat transfer rate falls off rapidly as solids build up on the container walls, and eventually becomes too slow for practical applications. However, when this point is reached, there may well remain a core of liquid within the container, representing a large fraction of the stored heat. A second disadvantage is the undesirable subcooling without crystallization which can occur if the storage salt containers are cooled without provisions to insure nucleation.

This paper describes a new technique for utilizing the heat of fusion of a storage material. The system is termed dynamic, since the heat transfer fluid flows through the salt to provide agitation plus direct contact heat exchange. Disodium phosphate dodecahydrate ($Na_2HPO_4.12H_2O$) was used for the storage material.

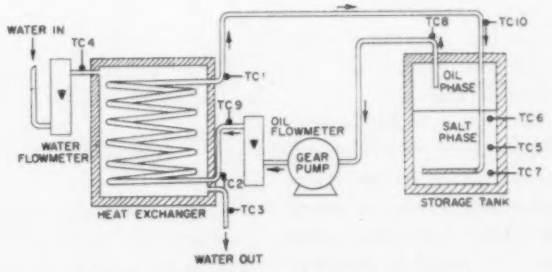

Fig. 1 — Dynamic heat storage apparatus

Objectives

The objectives of these experiments were as follows:

1. To demonstrate the feasibility of the dynamic heat storage system.
2. To assess the effect of agitation upon subcooling of the salt melt.
3. To assess the effect of direct-contact heat exchange upon heat transfer rates.

*Chemical Process Research, Research Laboratory, General Electric Co.

For presentation at the 64th Annual Meeting of the American Society of Heating and Air-Conditioning Engineers, Pittsburgh, Pa., January 1958.

[1]Exponent numerals refer to References.

4. To determine whether agitation of the disodium phosphate dodecahydrate would prevent crystallization of undesirable heptahydrate.

Equipment and Procedure

The heat storage system consisted basically of 2 heat exchangers and a circulating pump. A light mineral oil was circulated through a *usage* heat exchanger where heat was transferred from tap water to oil and from oil to tap water. The oil then bubbled through a *storage* heat exchanger in which it absorbed or rejected heat from or to the heat storage salt. Fig. 1 is a sketch of the apparatus.

Two layers existed in the storage tank with the oil as the top layer and the storage salt as the bottom layer. Oil was pumped from the top layer, through the heat exchanger (where it was heated or cooled by domestic hot or cold water) and discharged through a perforated pipe at the bottom of the salt layer. The oil absorbed or rejected heat as it rose through the storage salt phase.

Each run consisted of a freezing cycle starting from a melt temperature of about 130 F, immediately followed by a melting cycle to restore the salt to 130 F. The freezing cycle was considered complete when the temperature of the oil leaving the salt container reached about 80 F. The time between runs usually varied from 18 to 72 hr with the system being held at 130 F between each run. Runs 63 and 64 made up 4 continuous cycles each immediately following the other. Runs 65-66 and 67-80 were also consecutive cycles with the storage salt being held at 130 F for 90 hr between run 66 and run 67 (Table 1).

Data were taken at 2 to 5 min intervals during the first 20 min of a cycle and 10 to 15 min apart thereafter. Thermocouple locations are shown in Fig. 1. A slot cut in the insulation of the glass storage tank permitted visual inspection of both salt and oil phases.

The storage salt was prepared by adding water to technical grade anhydrous sodium phosphate to make 40.2 lb salt of composition corresponding to the dodecahydrate. The mixture was heated at about 150 F to produce a clear melt before charg-

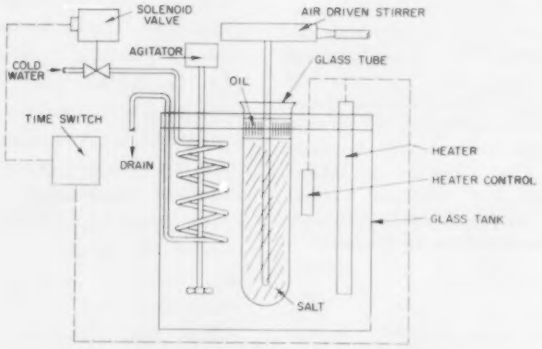

Fig. 2 — Apparatus for determining completeness of melting and freezing of $Na_2HPO_4.12H_2O$

Nomenclature

H_1 = heat released from or stored in salt as determined by energy balance on oil, Btu.
H_2 = heat released from or stored in salt as determined by energy balance on water, Btu.
ΣH_o = total heat released from or stored in storage tank and contents as determined by heat balance on oil, Btu.
ΣH_w = total heat transferred to or from water, Btu.
H_o = sensible heat in oil charge, Btu.
H'_T = sensible heat in storage tank, Btu.
H_p = pump energy plus or minus gains or losses from ambient between storage tank and heat exchanger, Btu.
H'_x = sensible heat in the heat exchanger, Btu.

Table 1 — Percent utilization of the heat of fusion of $Na_2HPO_4.12H_2O$

Run No.	Cycle (F = Freezing; M = Melting)	Duration, min	Heat Realized from Salt		Latent Heat Utilization, percent
			Latent + Sensible, Btu	Latent, Btu	
59	F	130	5112	3791	80
	M	80	4561	3144	66
60	F	135	5056	3747	79
	M	95	3687	2259	48
61	F	230	5616	4311	91
	M	115	4929	3754	79
62	F	140	6395	5238	110
	M	105	5410	4174	88
63	F	155	5219	4108	87
	M	80	4015	2747	58
64	F	128	4326	3002	63
	M	80	3802	2709	57
65	F	145	4844	3587	76
	M	80	3373	2195	46
66	F	130	4531	3244	68
	M	90	4059	2757	58
67	F	185	5918	4590	97
	M	190	4933	3631	77
68	F	170	4783	3421	72
	M	155	5506	4144	87
69	F	185	4160	3066	65
	M	111	3705	2664	56
70	F	145	4152	2903	61
	M	115	4250	2948	62
71	F	170	4613	3266	69
	M	122	4525	3178	67
72	F	155	4000	2653	56
	M	85	4266	2893	61
73	F	195	4776	3478	73
	M	145	4579	3281	69
74	F	120	3399	2086	44
	M	100	2984	1750	37
75	F	140	3863	2897	61
	M	100	3816	2850	60
76	F	180	4241	2932	62
	M	125	3780	2418	51
77	F	135	3543	2404	51
	M	120	3115	2055	43
78	F	115	3634	2724	57
	M	130	3297	2308	49
79	F	155	4548	3216	68
	M	125	4313	3010	63
80	F	167	3924	2767	58
	M	115	3907	2750	58

ing to the system. All runs were made using the same salt batch.

A separate experiment was made to assess the completeness of freezing and melting under conditions of more vigorous agitation than that supplied by the circulating oil. Salt of composition corresponding to the 12-hydrate was placed in a large glass test tube. A layer of light oil was added to the tube to provide a seal; an air-driven stirrer with a glass agitator was inserted in the tube, and the tube immersed in a water bath. A time switch actuated a cold water valve and resistance heater to provide a 3-hr cooling period followed by a 3-hr heating period. (See Fig. 2.) Cooling water temperature for freezing was 60 to 65 F. The bath temperature for melting was 130 F. The salt melted and froze completely for 220 six-hr cycles. The bath temperature for melting was lowered to 120 F and the salt again froze and melted completely for 40 six-hr cycles. The time required for complete melting at both bath temperatures was 45 min to 1 hr, about 20 min of which was required to raise the bath temperature from 60-65 F to the controlled bath temperature. Freezing required a total of 20-30 min, including the time required to lower the temperature from 120 or 130F.

Table 2 — Summary of continuous runs 67-80[a]

Cycle Type	Duration (min)	Heat Transferred to Water (Btu)	Pump Input (Btu)	Losses (Btu)	Latent Heat Stored or Removed (Btu)
Freezing	158	5462	528	30	2824
Melting	124	4946	40	80	2755

[a]Values shown are average.

Calculations

A heat balance was made for each cycle in the circulating system. Critical data for system components are listed in the Appendix. Symbols used in the calculations are as listed. Heat released from or stored in the salt was determined by graphical integration using oil flow rates and measured temperature difference between the oil entering and leaving the salt container.

$$H_1 = \Sigma H_o - H_o - H'_T \quad \ldots\ldots\ldots(1)$$

A second heat balance was made on the water to check the heat in the salt value obtained by the heat balance on the oil.

$$H_2 = \Sigma H_w \pm \text{Losses} \pm H_p - H_o - H'_T - H'_s \quad \ldots\ldots\ldots(2)$$

Heat input by the pump was determined similarly by using temperature differences in the oil between its exit from the storage tank and entrance to the heat exchanger. This value actually represents the net effect of pump input plus or minus gains or losses from ambient air temperature.

Sensible heat quantities for system components were calculated using initial and terminal temperatures for each cycle. The sensible heat in the liquid salt was calculated by assuming that it all crystallized at 96 F. The lowest of the 3 measured final salt temperatures was used to calculate the sensible heat in the solid. The latent heat effect was then obtained by subtracting the sensible heat in the salt from H_1. Salt utilization percentages (Table 1) represent only that amount of latent heat realized based on a value of 118 Btu per lb for the heat[3] of fusion of $Na_2HPO_4.12H_2O$.

Runs 67-80, consisting of 14 complete and consecutive cycle pairs, allowed a comparison between successive freezing and melting cycles to determine whether the heat stored during the melting cycle was recovered during the following freezing cycle.

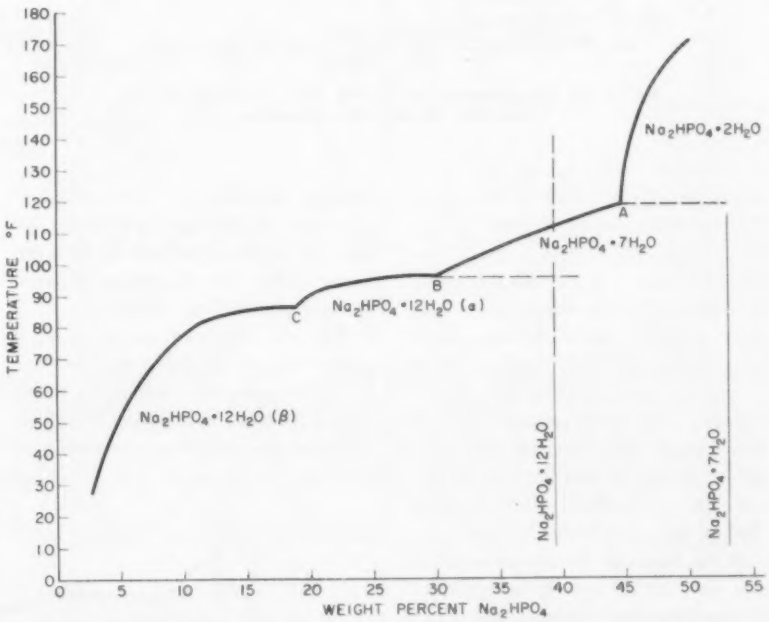

Fig. 3 — Phase diagram for the system disodium phosphate—water

$$\Sigma H_w \text{ (freezing)} - \Sigma H_w \text{ (melting)} = H_o \text{ (melting)} + H_p \text{ (freezing)} - \text{losses} \quad \ldots\ldots(3)$$

This comparison showed poor agreement between some cycle pairs, but when applied to the average values for 14 melting and freezing cycles the agreement was excellent. (See Table 2.)

Discussion

The phase diagram for the disodium phosphate-water system is repro-

duced in Fig. 3. Two crystallization mechanisms are proposed. Consider first the case when heat is removed under equilibrium conditions from a melt of $Na_2HPO_4.12H_2O$. The solution cools to about 112 F at which point $Na_2HPO_4.7H_2O$ starts to crystallize and liberate its heat of fusion. The solution becomes more dilute with temperature and composition following line A-B as the 7-hydrate crystallizes. As the temperature falls below point B, the 12-hydrate starts to crystallize and the 7-hydrate starts to pick up water to form also the 12-hydrate. (The latter process is much slower than the former.) Temperature continues to fall until all of the salt has crystallized. The reverse process takes place during melting.

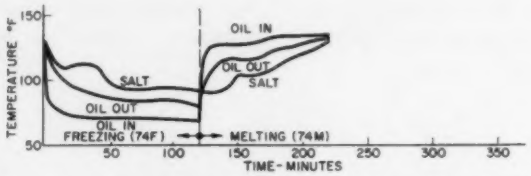

Fig. 4 — Temperatures for typical cycle resulting in low value for percent salt utilization

If the freezing process proceeds in this way, 56 percent of the salt crystallizes from the melt as the 7-hydrate, and 44 percent crystallizes as the 12-hydrate. The heats of fusion are 58 Btu per lb for the 7-hydrate and 118 Btu per lb for the 12-hydrate.[3] Therefore, it would be expected that the effective heat of fusion realized would be somewhere between 84 and 118 Btu per lb when the salt had completely crystallized from a melt. Assuming no 7- to 12-hydrate conversion, only 84 Btu per lb would be realized and about 0.14 lb of free water would remain when all the phosphate had crystallized. This would correspond to a utilization value of 71 percent.

A second mechanism of crystallization is possible when the system is metastable with respect to the heptahydrate. In this case the melt temperature can be successfully lowered through the region of heptahydrate stability without crystallization. Thus, the salt crystallizes entirely as the dodecahydrate. This would result in a salt utilization of 100 percent.

Agitation of the melt-solid mixture should increase the rate of conversion into 12-hydrate (Case 1) by avoiding large crystal agglomerates during that period when the 12-hydrate is crystallizing. More solid surface area would then be exposed for reaction of the heptahydrate with the water before the formation of large masses of blocking crystals.

The test tube experiment using a stirrer to provide violent agitation resulted in complete melting or freezing of the solid in less than 1 hr. The fact that the salt froze completely at 96 F without residual water indicates that the ultimate solid was indeed the 12-hydrate (Case 2).

Observations and measurements for runs where agitation was produced by circulating oil were as follows:

1. Freezing run yields were greater following an overnight or longer heating at a melt temperature of 130 F.
2. Freezing runs in which salt utilization approached 100 percent indicated no crystallization occurring above 96 F. (See Figs. 4 and 5.)
3. At the point in a melting run when the melt temperature reached 130 F, small amounts of fine solids remained suspended in the melt. These solids were reduced in quantity but not always completely removed by overnight heating at 130 F.

Correlation of salt utilization percentages with crystallization mechanism for this system is questionable. Others[5] have reported the very slow solution of the 7-hydrate; further, if a melt containing even small amounts of heptahydrate crystals is cooled, these crystals will seed the crystallization of more heptahydrate. Therefore, it is conceivable that the solids observed in the melt at 130 F were heptahydrate, which dissolved only after long heating at this temperature, and that more rapid solution of these crystals in the test tube was due to better agitation.

Since the latent heat utilization percentage obtained on freezing is a function of the crystallization mechanism and melt history, it reflects any erratic behavior of the storage material. If one assumes a clear melt which is metastable with respect to the heptahydrate, then a salt utilization percentage approaching 100 percent should be realized. Again, assuming a clear melt without metastability and without solid state conversion from the 7- to the 12-hydrate, then the utilization should be about 70 percent. Values between 70 and 100 percent might be due to lack of metastability but with some 7- to 12-hydrate conversion. Less than 70 percent utilization would indicate solids in the starting melt, no heptahydrate metastability and no solid state conversion.

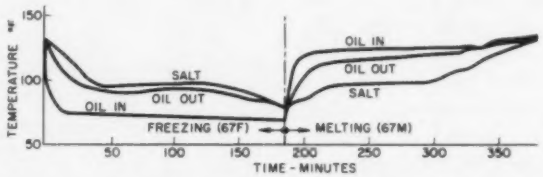

Fig. 5 — Temperatures for typical cycle resulting in high value for percent salt utilization

The utilization values obtained could be explained by mechanisms proposed above. Thus, low salt utilization yields were probably due to crystallization of heptahydrate as a

result of seeding by heptahydrate crystals formed during the preceding melting cycle. High yields resulted when a melt was successfully cooled to the temperature of dodecahydrate stability without crystallizing the heptahydrate. This demonstrates that the heat storage material must have a congruent melting point in order that its heat of fusion can be reliably realized.

Heat transfer rates were greatly improved over those reported for systems in which the storage salt was enclosed in sealed containers[3]. The oil flow rate varied from about 3 to 4 lb per min, and the temperature change in the oil across the storage container was 10 to 15 deg during that part of the freezing cycle during which latent heat was being transferred. Therefore, the minimum rate of heat transfer was about 800 Btu per hr. The excellent heat transfer was due to the high coefficients of heat transfer characteristic of direct contact heat exchange systems.

The oil bubble size was about ¼ in. in diam. Assuming no coalescence, a residence time of 1 sec and an average oil rate of 3.5 lb per min (surface area of 0.32 sq ft), an overall heat transfer coefficient of 125 Btu per (hr) (sq ft) (F deg) was calculated for the minimum heat transfer rate.

The salt volume was 0.45 cu ft, and the oil volume was 0.43 cu ft. No attempt was made to minimize the oil volume; however, the minimum amount of oil required is that which will prevent picking up salt phase in the pump suction. Based on salt volume alone, the minimum latent heat realized on salt freezing was 4650 Btu per cu ft (cycle 74 F, Fig. 4), and the maximum was 10,200 Btu per cu ft (cycle 67 F, Fig. 5). Sensible heat in the salt is not included in these values.

APPENDIX

Critical Data for Heat Storage System

1 *Storage Tank*

Material	Glass
Weight	15 lb
Exterior surface	6.3 sq ft
Heat transmission coefficient	0.1 Btu per (hr) (sq ft) (F deg)

2 *Heat Exchanger*

Concentric copper coil
Length — 50 ft; ⅜-in. OD within ¾-in. OD
Weight — 21 lb
CP — 0.1
Exterior surface — 6.3 sq ft
Heat transmission coefficient — 0.1 Btu per (hr) (sq ft) (F deg).

3 *Heat Exchange Oil*

Paraffin base mineral oil
Viscosity — 32 Saybolt sec at 100 F
Sp gr — 0.85
CP — 0.46

4 *Storage Salt*

Aqueous Na_2HPO_4
Weight — 40.2 lb
Composition — $Na_2HPO_4 \cdot 12H_2O$
CP (solid) — 0.37
CP (liquid) — 0.65
Sp gr — 1.42
Heat of fusion — ($Na_2HPO_4 \cdot 7H_2O$), 58 Btu per lb
($Na_2HPO_4 \cdot 12H_2O$), 118 Btu per lb

Conclusions

1. The performance of a dynamic heat storage technique using the heat of fusion of a storage material has been demonstrated.

2. Subcooling of the heat storage melt was virtually eliminated as a result of the agitation produced when a nonsoluble heat exchange oil was bubbled through the storage phase.

3. Excellent rates of heat transfer were obtained as a result of direct contact heat exchange.

4. The complex crystallization mechanism of the aqueous disodium phosphate system resulted in large variations in the amount of heat able to be stored and released.

References

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2. Chemical Heat Storage for Heat Pumps by the joint committee of the *Association of Edison Illuminating Companies* and *Edison Electric Institute* (*Refrigerating Engineering*, Vol. 60, July 1952, p. 719).

3. Heat Storage Using Disodium Phosphate Dodekahydrate, by E. R. Ambrose (American Gas and Electric Service Corp. Confidential Report, January 1952).

4. Heat Storage Systems, by J. P. Howe and R. Katucki (General Electric Co. Research Laboratory Memo Report P-7, 1952).

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7. Mechanism of Heat Transfer to Liquid Drops, by R. V. McDowell and J. E. Myers (*AIChE Journal*, September 1956, pp. 384-388).

8. *Process Heat Transfer*, by D. Q. Kern (McGraw-Hill Book Co., Inc., New York, 1950, p. 563).

9. A Review of Solar House Heating, by Maria Telkes (*Heating and Ventilating*, July 1949, pp. 68-74).

10. *International Critical Tables of the Numerical Data of Physics, Chemistry and Technology*, Vols. I to VII, published under the direction of the *National Academy of Science* and the *National Research Council* (McGraw-Hill Book Co., Inc., New York, 1926-1930).

Professor Tuve Will Receive Anderson Medal

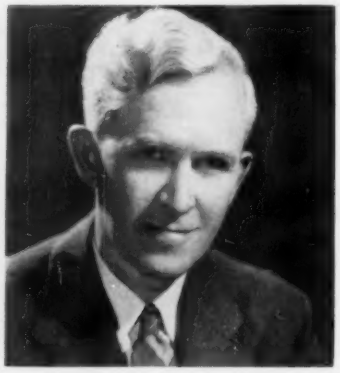
A past president of the Society, George Lewis Tuve, professor of mechanical engineering and director of Bingham Laboratories, Case Institute of Technology, has been named to receive the sixteenth award of the F. Paul Anderson Medal. This presentation, which is given in recognition of outstanding work in the field of heating, ventilating and air conditioning, will be made at the Annual Banquet on January 29, at the conclusion of Society's 64th Annual Meeting.

Professor Tuve has distinguished himself in the teaching profession and as a consulting engineer in the field. He is co-author, with C. F. Shoop, of a textbook entitled *Mechanical Engineering Practice,* which is used widely in engineering colleges, and he has been a contributor to a number of technical handbooks and journals.

His appointment as director of Bingham Laboratories at Case Institute of Technology, Cleveland, Ohio, became effective on July 1st of this year. Professor Tuve brought to this new position an extensive background of active instruction and departmental direction, with 13 years recent experience as head of the department of mechanical engineering at the Institute.

Beginning in 1914, Professor Tuve attended Northwestern University, Augustana College and the University of Minnesota. In 1921, after two years in industry he received his M.E. from the University of Minnesota and joined the faculty as an instructor, later advancing to assistant professor of mechanical engineering. He served in 1924-5 as assistant professor of mechanical engineering at the University of Montana. Transferring to the Texas Technological College he was named professor and head of the department of mechanical engineering there in 1927. He first became affiliated with Case Institute, then the Case School of Applied Science, in 1930 as associate professor of mechanical engineering, in charge of the heat-power division and mechanical engineering laboratory. He advanced to full professor in 1934 and became departmental head in 1945.

In the course of his industrial career, Professor Tuve has acted as



a consultant on research and development work with such firms as the Allis-Chalmers Manufacturing Co., American Locomotive Co. and the Public Service Company of Northern Illinois. He has specialized in heat transmission, air flow and instrumentation.

Since he joined the Society in 1932, Professor Tuve has served in many capacities, culminating in the presidency in 1948. He served a 3-year term on the Council beginning in 1939, and was selected as 2nd and 1st vice president previous to his presidential term. While a member of Council, he served as a member of the Standards, Meetings and Executive Committees, and as chairman of the latter two. After some years as a member, he became chairman of the Committee on Research and of its Executive Committee for 1944 and 1945. In addition to lengthy service on numerous technical advisory committees, Professor Tuve has also served on the Committee on Technical Papers, the F. Paul Anderson Award, Guide Publication, Nominating, Public Relations, and Awards Committees. He has been an active member of the Northern Ohio (formerly Cleveland) Chapter, having served on the board of governors for many years and as its president in 1935.

Besides his ASHAE membership, Professor Tuve holds membership in *ASME, ASEE, National Society of Professional Engineers, Cleveland Engineering Society,* Tau Beta Pi and Sigma Xi.

The award which Professor Tuve is to receive was named after Dean F. Paul Anderson of the University of Kentucky, who was president of the Society in 1927. The F. Paul Anderson Medal was established in 1930 through a gift to the Society by Thornton Lewis of Philadelphia, Pa., who served the Society as president for 1929.

Members of the 1957 F. Paul Anderson Award Committee are E. R. Queer, University Park, Pa., chairman; John Everetts, Jr., Philadelphia, Pa.; John W. James, Chicago, Ill.; A. J. Nesbitt, Philadelphia, Pa.; and F. B. Rowley, Minneapolis, Minn.

Season's Greetings

With all best wishes for a very

Merry Christmas

and a most happy and enjoyable

New Year

Peter Ben Gordon

President

ASHAE Annual Meeting Next Month

One month away . . . the beginning of a new year and, a few weeks later, the opening of another ASHAE Meeting; the 64th Annual Meeting, January 27-29, 1958 in the Penn-Sheraton Hotel, Pittsburgh, Pa.

A good way to approach a new year in this rapidly expanding heating and air-conditioning industry is to secure firsthand the technological information, prepared by professional colleagues, which will be presented during 7 technical sessions set up by the Program and Papers Committee, John Everetts, Jr., Philadelphia, Pa., chairman.

Pres. P. B. Gordon, New York, N. Y., will call to order the 64th Annual Meeting at 9 o'clock Monday morning, January 27, and following the reports of the President and of Treas. C. H. Pesterfield, East Lansing, Mich., a Topical Session on Solar Energy will commence with R. C. Jordan, Minneapolis, Minn., as chairman.

Upon conclusion of the First Session a Welcome Luncheon will be held with an outstanding speaker, the presentation of certificates to Fellows, and presentation of the ASHAE-Homer Addams Award.

There is no session scheduled for Monday afternoon and members may use this time to advantage by participating in the inspection trips planned by the Pittsburgh Chapter Committee on Arrangements, T. F. Rockwell, general chairman.

Three trips are arranged, all scheduled for 2 o'clock departure from the hotel.

1. H. J. Heinz Co. home factory where visitors can see many of the famous *57 varieties* being made and catch a glimpse of extensive research and quality control activities.

2. Pittsburgh Area sightseeing to view the progress made through one of the greatest modernization and redevelopment programs ever undertaken by a city. Glittering skyscrapers have replaced old buildings.

3. Buhl Planetarium theater of the stars reproduces the skies on a 65-ft perforated stainless steel dome. The Zeiss Planetarium projector, one of 5 in the United States, shows each naked-eye star glittering in its proper position.

The Pittsburgh tour and the Buhl Planetarium are scheduled again for Tuesday afternoon at 1:30. Monday, Tuesday and Wednesday, between 10:00 a.m. and 4:00 p.m., groups of up to 10 persons will be taken on conducted tours of the 30-story Alcoa Building to see the country's first ceiling panel heating and cooling installation.

Ladies not interested in sightseeing on Monday afternoon may find the Tea and Entertainment at 2:30, in the hotel both relaxing and entertaining. Featured will be Nan Neugebauer, popular Pittsburgh comedienne, and her *Nan about Town* program of humor and satire at the piano.

The first day of the Annual Meeting will conclude with a Gay Nineties Get-Together Party Monday evening.

Tuesday morning at 9:30 the serious nature of the Annual Meeting continues with 2 simultaneous sessions. 1st Vice Pres. E. R. Queer, University Park, Pa., will call to or-

(*continued on p. 155*)

PROGRAM — 64TH ANNUAL MEETING

Penn-Sheraton Hotel, Pittsburgh, Pa. **January 27-29, 1958**

SYMPOSIUM ON HIGH TEMPERATURE WATER (*cont'd*)

Saturday — January 25

10:00 a.m. Committee Meetings

Sunday — January 26

10:00 a.m. Council Meeting
1:30 p.m. REGISTRATION

Monday — January 27

9:00 a.m. REGISTRATION
9:00 a.m. FIRST SESSION
Call to Order — Pres. P. B. Gordon
Report of President — P. B. Gordon
Report of Council — A. V. Hutchinson
Report of Treasurer — C. H. Pesterfield
TOPICAL SESSION ON SOLAR ENERGY
R. C. Jordan, *Chairman*
Direct Solar Radiation Available on Clear Days, by J. L. Threlkeld and R. C. Jordan
A High-Flux Low-Temperature Solar Collector, by R. G. Nevins and P. E. McNall, Jr.
Performance of a Solar Heated Office Building, by F. H. Bridgers, D. D. Paxton and R. W. Haines
Sun Energy Assistance for Air-Type Heat Pumps, by C. P. Davis, Jr. and R. I. Lipper

12:30 p.m. WELCOME LUNCHEON
Speaker: Hon. David L. Lawrence, Mayor of Pittsburgh
Subject: Pittsburgh, A City Whose Dreams Come True
Presentation of Certificates to Fellows
Presentation of ASHAE — Homer Addams Award

2:00 p.m. Inspection Trips
2:30 p.m. Ladies' Tea and Entertainment
9:30 p.m. Gay Nineties Party

Tuesday — January 28

9:00 a.m. REGISTRATION
9:30 a.m. SECOND SESSION
Call to Order — 1st Vice Pres. E. R. Queer
Report of Committee on Research — H. A. Lockhart, *Chairman*
Report of Inspectors of Election
Cooling Load from Thermal Network Solutions, by Harry Buchberg
The ASHAE Air-Borne Dust Survey, by K. T. Whitby, A. B. Algren, R. C. Jordan and J. C. Annis
Natural Convection Cooling and Dehumidifying, by L. G. Seigel and W. L. Bryan
Stable Hot-Wire Anemometer for Low Speeds, by J. F. Kemp (by title only)

9:30 a.m. THIRD SESSION
Call to Order — 2nd Vice Pres. A. J. Hess
SYMPOSIUM ON HIGH TEMPERATURE WATER
P. N. Vinther, *Moderator*
Economic Evaluation of High Temperature Water, by E. M. Thompson
Marine Application of High Temperature Water, by S. W. Brown
Design of High Temperature Water Systems for Military Installations, by C. A. Carter and B. L. Sturdevant
Heating and Air Conditioning a Civilian Airport, by Charles Broder
British and European Design and Construction Methods, by George Applegate, Jr.
Report of Inspectors of Election

10:00 a.m. Ladies' Bus Tour and Luncheon
12:15 p.m. Dutch Treat Luncheon — Life Members Club
1:00 p.m. Inspection Tours
1:30 p.m. Nominating Committee Meeting
7:00 p.m. Past Presidents' Dinner
8:00 p.m. Chapter Editors' Conference, B. W. Farnes, *Chairman*

Wednesday — January 29

9:00 a.m. REGISTRATION
9:30 a.m. FOURTH SESSION
Call to Order — Pres. P. B. Gordon
Effect of Heated-Floor Temperatures on Comfort, by R. G. Nevins and A. O. Flinner
Lighting and Cooled Air Effects on Panel Cooling, by L. F. Schutrum and T. C. Min
Radiant Drafts from Cold Ceilings, by H. E. Ronge and B. E. Lofstedt

9:30 a.m. FIFTH SESSION
Call to Order — Treas. C. H. Pesterfield
Local Climatic Weather Data, by W. L. Holladay
A Dynamic Heat Storage System, by T. L. Etherington
Improving Attic Space Insulating Values, by F. A. Joy

2:00 p.m. SIXTH SESSION
Call to Order — 1st Vice Pres. E. R. Queer
Chimney and Stack Design for Gas-Fired Equipment, by R. L. Stone
Pressure Losses and Flow Characteristics of Multiple-Leaf Dampers, by E. J. Brown and J. R. Fellows
Fan Noise Variation with Changing Fan Operation, by R. D. Madison and J. B. Graham

2:00 p.m. SEVENTH SESSION
Call to Order — Pres. P. B. Gordon
SYMPOSIUM ON SCHOOL HEATING, VENTILATING AND AIR CONDITIONING
W. G. Hole, *Moderator*
Educator's View of Need for Good Classroom Environment, by G. B. Wadzeck
HV&AC Design Practice for Schools, by Henry Wright
Economics of School Heating and Air Conditioning, by Z. A. Marsh
State Board Problems — Financing and Others, by C. B. Hershey
Looking Into the Future, by E. G. Good
Report of Resolutions Committee
Unfinished Business
New Business
Adjournment

7:00 p.m. ANNUAL BANQUET
Toastmaster: Thomas Pratt; Member of Ingham, Boyd & Pratt, Architects
Speaker: Allison R. Maxwell, Jr. President, Pittsburgh Steel Co.
Subject: What Steel Stability Means to You
Introduction and Installation of 1958 Officers
Presentation of F. Paul Anderson Medal
Presentation of Past President's Award to P. B. Gordon

Thursday — January 30

9:00 a.m. Organization Meeting of 1958 Council

(continued from p. 153)

der the Second Session and 2nd Vice Pres. A. J. Hess, Los Angeles, Calif., will do likewise at the Third Session.

An interesting bus tour for the ladies starts at 10 a.m. Tuesday, with a luncheon in the University Club at the University of Pittsburgh.

Three inspection Trips are planned for Tuesday afternoon; departing from the hotel at 1 o'clock.

1. Homestead Steel Works (men only), the largest U. S. Steel Corp. plant in the east.
2. Gulf Oil Corp. Research Laboratories, Harmarville, Pa.; modern nuclear science laboratory.
3. Pittsburgh Consolidated Coal Co. (men only) coal cleaning and processing operation at Monongahela Mine.

Four sessions are scheduled for Wednesday, the final day of the Annual Meeting; 2 in the morning and 2 in the afternoon. President Gordon will preside at the Fourth Session and the Fifth Session will be called to order by Treasurer Pesterfield. The Sixth Session will be opened by 1st Vice President Queer, and President Gordon will call to order the concluding session.

Preceding the festivities of the Annual Banquet Wednesday evening, the ladies will have a luncheon at 1 o'clock at which time they will be addressed by Earl Wheeler head of the Earl Wheeler Finishing School of Pittsburgh. Mr. Wheeler will give a capsule charm course, including appearance, posture, speech, social graces, fashion and a demonstrated explanation of the proper use of make-up.

Allison R. Maxwell, Jr.
Banquet Speaker

Nan Neugebauer
Ladies Tea

R. M. Meucci, chairman, Reception and Registration. Mrs. B. B. Reilly, co-chairman, Ladies Activities

The climax of every Annual Meeting is the Annual Banquet and the Pittsburgh Chapter Committee on Arrangements has extended an invitation to Allison R. Maxwell, Jr., President of Pittsburgh Steel Co., to deliver the banquet address. His subject will be *What Steel Stability Means to You*. Toastmaster will be Thomas Pratt, Pittsburgh architect.

Mr. Maxwell, a native of Pittsburgh, was elected president of Pittsburgh Steel in 1956 after 21 years in the steel business, a career which began in the company mills at Monessen and Allenport.

Since 1948 he has served on different steel industry advisory committees to the Federal Government, and in the industry as a member of the *American Iron and Steel Institute* and the *American Petroleum Institute*. In addition he has also found time for active participation in many local charitable and philanthropic organizations.

The introduction and installation of the 1958 Officers, the presentation of the F. Paul Anderson Medal, and the presentation of the Past President's Award to President Gordon will be features of the Annual Banquet Program.

GORDON NAMED TO BOARD OF BRI

Pres. P. B. Gordon, New York, N. Y., has been appointed as a member of the Board of Governors of the *Building Research Institute*, Washington, D. C.

Appointment is for a three-year term ending June 30, 1960. The Institute is a part of the *National Academy of Sciences-National Research Council*, a private non-profit organization, with more than 1200 members.

The Institute maintains liaison with building research centers throughout the world.

MEMBERS ACTIVE AT AAAS MEETING

The Engineering Section of the *American Association for the Advancement of Science* (Section M) has planned a program of 2 sessions as a part of a meeting of the Association on December 26-31, 1957 at Indianapolis, Ind.

The sessions are being held on December 30th. Prof. C. F. Kayan, New York, N.Y., is chairman of the *AAAS* Committee which organized the program, while C. S. Leopold, Philadelphia, Pa., is presenting a paper on the subject *Engineering Aspects of Indoor Comfort Data*.

BAKER MADE KENTUCKY RESEARCH DIRECTOR

Merl Baker, Lexington, Ky., has a new relationship with the University of Kentucky, whereby he continues as executive director of the Kentucky Research Foundation, and part-time professor of mechanical engineering, and in addition becomes Director of Research and Industrial Relations for the University.

This is a new position with the objective of formulating policy and progress in the area of research, industrial relations and special projects.

Professor Baker has been active in Society affairs and a frequent contributor of papers for Society meeting programs.

WINANS RECEIVES PROMOTION

Glen D. Winans has been promoted to general superintendent of the central heating department, Detroit Edison Co., Detroit, Mich. Starting in the company's central heating department as an inspector in 1921, Mr. Winans held a number of supervisory posts over the years, including

steam distribution engineer and assistant superintendent. Previous to his recent promotion, his position was assistant general superintendent.

Since joining the Society in 1929, Mr. Winans has served in many capacities. He was a member of the Council for 3 years beginning in 1943. Through the years he has acted as chairman of the Membership, Chapter Relations, and Admission and Advancement Committees, and the TAC on Panel Heating. In 1934, he was president of the Michigan Chapter.

FALL MEETING OF THE COUNCIL

The regular fall meeting of the Society Council took place at the Hotel Statler in Cleveland on October 12. As usual, it was a busy meeting and apart from the more or less routine matters which have to be considered by the Council, many additional important matters were taken up.

The personnel of the Guide Committee for 1958 continues to be the same as for 1957, but H. W. Alyea, Milwaukee, Wis., becomes chairman.

In connection with the matter of honors and awards, it was indicated that G. L. Tuve, Cleveland, Ohio, is selected as the sixteenth recipient of the F. Paul Anderson Award. The ASHAE-Homer Addams Award is to be conferred and a recipient designated by the University of Illinois is to be selected. It was voted that the grade of fellow be conferred on 8 outstanding members of the Society, namely: A. L. Baum, New York, N.Y.; A. C. Buensod, New York, N.Y.; I. W. Cotton, Indianapolis, Ind.; E. L. Crosby, Baltimore, Md.; E. P. Heckel, Chicago, Ill.; Carl F. Kayan, New York, N.Y.; F. B. Rowley, Minneapolis, Minn.; G. M. Simonson, San Francisco, Calif.

For some time, the Council has been considering the matter of changes and revisions of a pension and insurance program for Society employees and a new program was authorized.

The Council also approved the total operating Budget for the Society for the fiscal year 1958 in the amount of just over $700,000. A proposed schedule for the location of regional meetings for 1958 was approved with meetings in the 7 regions taking place between the middle of March 1958 and the latter part of May.

The Council voted that charters be granted to the 70th, 71st and 72nd chapters located respectively in Savannah, Ga., Long Island, N. Y., and Southern Alberta, Canada.

The Council approved the names for 2 new chapter publications. The Washington, D.C. Chapter publication is to be known as the *Capitalaire*, while the publication of the Cincinnati Chapter is to be known as the *Cincinnati Circulator*. This authorization brings the chapter publications to a total of 30.

In connection with the research property at Cleveland, the Council authorized an expenditure of $8000 for repairs and improvements to the building. The Council also authorized President Gordon to advise the United Engineering Trustees that the Society will participate in the new engineering center in New York City. This building is to be located on the west side of First Ave. from East 47th St. to East 48th St., facing the United Nations Plaza. It is expected that the proposed building will be ready for occupancy in 1960.

In addition to the actions mentioned, various others were taken at the meeting including appointment of the Nominating Committee, changes in details of handling of fellow designations, possibility of additional awards and honors, advertising rates for THE GUIDE, consideration of meeting locations in future years, adoption of various recommendations of the Admission and Advancement Committee concerning membership.

Council also received reports from its various committees including the Program and Papers Committee, the Exposition Committee, and the Regions Central Committee.

Also, at this meeting the title of F. W. Hofmann of the Society staff was changed to assistant secretary.

HONORED BY LIFE MEMBERSHIP

by recent action of Society's Council

John M. Hartman

Kewanee, Ill.: ▸ Associated with Kewanee Boiler Division 36 years; now manager of research.
▸ Was graduated from University of Kansas, with B.S.
▸ Received double wings, Signal Officers Reserve Corps.
▸ Known for experience in performance of steel boilers.
▸ Contributed to THE GUIDE.
▸ Holds membership—board of governors, Illinois-Iowa Chapter; *NSPE;* life membership, *ASME.*

Edwin A. Jones

Cincinnati, Ohio: ▸ Is an engineering & management consultant.
▸ Associated with Century Engineering Corp., Cedar Rapids, Ia., as director of engineering, 1951-6.
▸ Served on ASHAE committees: Nominating (chairman), Guide Publication, Technical Advisory; also *A.G.A., NWAH & ACA, OHI* committees; *GAMA* member.
▸ Joined St. Louis Chapter, 1919; Wisconsin Chapter president, 1931.
▸ Helped prepare codes, standards.

Raymond T. Kern

Fitchburg, Mass.: ▸ Connected with the Jennison Co., as chief engineer for past 43 years.
▸ Served on Council, 1952-5.
▸ Active on Society committees: Chapters Conference, Nominating (chairman), Membership, Program and Papers, Public Relations.
▸ Elected Massachusetts Chapter president, 1949; *NSPE* member.
▸ Contributed to THE GUIDE.
▸ Wrote technical papers for JOURNAL & trade periodicals.

Robert W. Otto

St. Paul, Minn.: ▸ Associated with Toltz, King, Duvall, Anderson & Associates as mechanical engineer in charge of the mechanical department since 1930; also treasurer of corporation.
▸ Received M.E. from University of Minnesota, 1904.
▸ Employed by Andrews Heating Co., Minneapolis, Minn., 1904-30, as engineer & treasurer.
▸ Holds membership in Sigma Xi and Tau Beta Pi.

DAFTER AND CHURCH REASSIGNED

Word has been received that E. H. Dafter, Philadelphia, Pa., has been assigned to the position of regional manager of the Eastern Division of Carrier Corporation with headquarters in Philadelphia.

It is also announced that L. M. Church, a long-time member of the Society, becomes an advisory consultant in the regional office.

RATHER RETIRES

Maxwell F. Rather, vice president and district and export manager, Johnson Service Co., New York N.Y., retired October 1, 1957. He continues as manager of the Export Division, consultant to the sales staff and member of the board of directors. After serving his company in Dallas, Kansas City, Omaha and Cleveland, Mr. Rather in December 1937 assumed management duties in New York. He has been a member of the Society since 1919.

ACTIVITIES OF SOCIETY CHAPTERS

Along with an array of other excellent Technical Talks at recent chapter meetings, some of the chapters heard Regional Directors Speak and a few presentations were made Featuring Design. The Names in the News this month gained prominence in their chapters for a wide variety of reasons.

Regional Directors Speak

P. J. Marschall, regional director, Region 2, addressed the members and guests of the MIAMI VALLEY Chapter. Mr. Marschall, who is manager of engineering, Abbott Laboratories, North Chicago, Ill., explained how a work situation which causes fatigue, irritability, and discomfort can indirectly cause a loss in productivity. According to Mr. Marschall, control of temperature and humidity provides better working conditions and additionally should result in more uniform quality of products. He pointed out how extremes in heat, cold, humidity, fumes, dust and radiation can reduce efficiency through the worker's losing body energy while adjusting to extremes of environment. At the conclusion of his technical presentation, Mr. Marschall explained some regional matters and the qualifications for advancement of membership grade. • • • The regional director of Region 4, W. O. Stewart, was the speaker at an OREGON Chapter meeting. Mr. Stewart, who is manager, Johnson Service Co., Los Angeles, Calif., discussed *High-Velocity Air-Conditioning Systems*. He explained why high-pressure high-velocity double- or single-duct ventilation and air-conditioning systems were designed primarily for larger multistoried buildings. In elaborating on this subject, it was pointed out that where space is expensive and desired for functional use not much room can be afforded for mechanical rooms and volume-demanding low-velocity ventilating sheet metal ducts. Mr. Stewart did hasten to add, however, that all buildings are not adaptable for high pressure and that selection of a system naturally depends upon the existing and new structure, size economics and building function.

Technical Talks

Elmer Juneau, representative, Carrier Corporation, St. Louis, Mo., gave the history and background of *Absorption Refrigeration* for the benefit of an ARKANSAS Chapter audience. Slides were shown to simplify the basic principles of absorption. At another meeting of the chapter, William Gardner, district sales engineer for the southern area, Cyclotherm Division, National-U. S. Radiator Corp., Birmingham, Ala., spoke on *Packaged Steam Generators in the Industrial Field*, primarily covering heat transfer equipment with natural gas. Slides depicted different types of boilers in various stages of construction, and a model burner was demonstrated to show the principle of operation. • • • In an interesting talk on *Automobile Air Conditioning* given from the Connecticut Chapter rostrum, W. H. Jackson, senior project engineer, Harrison Radiator Division, General Motors Corp., Lockport, N.Y., predicted a tremendous growth in air-conditioned cars in the next 3 years. • • • F. L. Vaughn, Sporlan Valve Co., St. Louis, Mo., gave an excellent presentation on the *Thermostatic Expansion Valves, Theory of Operation and Application Engineering*. DELTA Chapter members heard Mr. Vaughn discuss the refrigeration cycle, proper installation and maintenance. • • • An EL PASO Chapter guest speaker, Neil Kelly, manager of engineering and production, J. F. Pritchard Co., Kansas City, Mo., advised important consideration in the selection of cooling towers for air conditioners at 100 tons or greater. • • • The speaker at an EMPIRE STATE CAPITAL Chapter meeting, J. E. Campbell, selected *Powering by Coal* as his subject. Slides and a motion were enjoyed by all present. In thanking the speaker afterwards, M. E. Waddell noted that many new thoughts were gained from this presentation. • • • A lively question and answer period followed a talk entitled *High Velocity Air Distribution Systems*, given at an ILLINOIS-IOWA Chapter meeting by H. H. Koroff, Johnson Service Co., Milwaukee, Wis. • • • At recent meetings of the KANSAS Chapter, programs were presented on *Air Velocity Control in High and Low Pressure Duct Systems*, with J. H. Colby, Johnson Service Co., Milwaukee, Wis., as the speaker, and on the use of electricity for heating, with K. N. LaRue, Kansas Gas and Electric Co., giving the presentation. • • • An informative talk on *Motor Starting Methods* was given by Max Johnson at a meeting of the KANSAS CITY Chapter. • • • John E. Haines, a past president of the Society and vice president, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., delivered a factual address on *The Economic Advantages of Complete Year-Round Air Conditioning* before his fellow members of the MINNESOTA Chapter. • • • At a joint meeting of the NEW MEXICO Chapters of *AIA* and ASHAE, J. I. Yellott, secretary-treasurer, *Association for Applied Solar Energy*, spoke on *Solar Energy—Today and Tomorrow*. Mr. Yellott also displayed the 10 top entries in the Solar House Architectural Competition and discussed them with his audience. • • • Members and guests of the NORTH JERSEY Chapter heard H. A. Sampson, Time Equipment Division, International Business Machines Corp., Newark, N.J., describe equipment for carrier current supervision of heating, air conditioning and ventilating systems, as well as time recording, control of lighting and other functions where a remote master control is desired. Arthur Zeitleir, district sales engineer for the IBM Time Equipment Division, demonstrated the operation of sample equipment on the stage. • • • The feature at a PHILADELPHIA Chapter meeting was a talk by W. C. Heck on *Absorption Refrigeration—Application and Economics*. • • • SACRAMENTO VALLEY Chapter scheduled an enlightening vocal and film presentation on *Hood Designs* and their applications with various types of dust control methods. Supplementary talks were given by George McGrew, superintendent, Dunphy Sheet Metal Products, Sacramento, Calif., on local codes pertaining to commercial range hoods, and by V. W. Thornberg, senior mechanical engineer, Division of Architecture, State of California, Sacramento, on codes covering garage exhaust systems. • • • In a talk on *Heating and Air Conditioning of Multi-stories Buildings* given at a TOLEDO Chapter meeting, R. J. Salinger, air-conditioning and ventilating engineer, Naess & Murphy, Chicago, pointed out that commercial air conditioning received a big boost in the early 1920's in theaters, then restaurants, funeral parlors and night clubs. The speaker noted that air-conditioning requirements of multi-story buildings differ greatly from those single-occupancy businesses. Mr. Salinger feels that the greatest concern in office building design is flexibility. He told his audience that, as people became more accustomed to air conditioning, satisfactory summer inside design temperature dropped about 5 degrees since the early days of air conditioning. In addition to this main talk, the chapter scheduled one of a series of coffee talks designed to acquaint the members with THE GUIDE. G. R. Munger spoke briefly on Chapter 9, Heat Transmission Coefficients of Building Materials, and he urged the members of familiarize themselves with this chapter and to use it frequently. • • • F. J. Linsenmeyer, sales engineer, The Nichols Co., Detroit, Mich., gave an interesting talk before a WEST-

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ERN MICHIGAN Chapter audience. He dealt with *Ceiling Radiant Heating and Cooling*, treating the advantages of radiant ceiling panels in comparison with floor and wall panels. Numerous slides were shown illustrating actual installations and design characteristics.

Featuring Design

Problems of Coordinating Heating and Air-Conditioning Design were covered in a talk presented at an ARIZONA Chapter meeting. The speaker, Ed Varney, told of some of the forward thinking being done in the field of architectural design and expressed the belief that the heating and air-conditioning profession should also be thinking in terms of new types of design and equipment to stay in pace with architecture. Mr. Varney's excellently prepared speech was followed by a period of questions, with everyone defending himself. • • • At an ATLANTA Chapter meeting, R. A. Gonzalez, director of application engineering, Airtemp Division of Chrysler Corp., presented an illustrated discussion on the *Influence of Air Conditioning on Architectural Design*. The program was well received by the members.

Names in the News

Vice Pres. J. L. Rea, Jr., invited the AUSTIN Chapter members to attend the informal meeting of the Region 6 Chapters Regional Committee scheduled for October 4 at the S. F. Austin Hotel, with Regional Director D. M. Mills, Houston, Tex., conducting the meeting. • • • The officers for the 1957-58 season of the CENTRAL NEW YORK Chapter were installed by H. K. Ormsby. L. A. Childs conferred the past presidents pin on H. J. Morton. Framed certificates of appreciation were presented to the 12 past presidents of the Chapter, who were honored guests for the evening. The members were surprised and pleased that H. G. Strong, 1948 president, came from Washington, D.C., to attend the meeting. • • • DELTA Chapter paid recognition to R. D. Lewis for editing the first edition of the *Delta Digest* for this year and to A. F. Lusch for his work as publicity chairman. • • • J. H. Brooks was appointed as secretary of the EL PASO Chapter to fill the vacancy created by the resignation of M. W. Schlessinger. A nominating committee composed of F. A. Huchet, Jr., R. O. Gibson and Harry Kerbow was also appointed. • • • A Life Membership certificate was presented by A. B. Algren to R. W. Otto, MINNESOTA Chapter r ember. In accepting the Life Membership, Mr. Otto gave an enjoyable report on the design of heating systems at the turn of the century and on his expectations for future heating systems. • • • A bound series of copies of the OREGON Chapter publication, the *Diffuser*, was presented to R. W. Zanders, retired editor-in-chief. A. D. Hughes, another member of the Oregon Chapter, was commended for his success in interesting students in the air-conditioning and heating industry. The custom of handing down a Swiss bell to succeeding presidents was revived, and Pres. W. B. Hayes became the new caretaker of the cherished symbol after a formal presentation by D. L. Benz. • • • At a PHILADELPHIA Chapter meeting, dual presentations were made. A. J. Nesbitt presented H. B. Hedges with his Life Membership certificate, and R. P. Schoenijahn made the presentation to J. H. Hucker. • • • Pres. M. J. Delavan, SACRAMENTO VALLEY Chapter, reported that E. J. Varvello had been elected by the board of governors to replace R. J. McKinnon, who had tendered his resignation. • • • During a SOUTHERN CALIFORNIA Chapter meeting, A. J. Hess, 2nd vice president of the Society, proposed a vote of thanks to Leo Hungerford, W. L. Holladay and their committee for the excellent work done on the design temperature conditions for Arizona, Southern California and Nevada.

CANDIDATES FOR MEMBERSHIP

Listed here are the names of 121 men who are candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility of receiving these candidates into membership by advising the Executive Secretary before December 31, 1957, of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted upon by the Council.

Note: **Advancement* †*Reinstatement*

Arizona (*Region* 4)

BELL, J. R.†, Br. Mgr., Machinery & Systems Div., Carrier Corporation, Phoenix.

JOACHIM, R. E., Engr., John Paul Jones, Tucson.

THOMAS, R. D., Plt. Supt., Continental Mfg. Co., Phoenix.

California (*Region* 4)

ARMSTRONG, R. I., Pres., Tuttle & Bailey Pacific, Inc., Industry.

CLARK, W. L., Sales Engr., The Marley Co., San Francisco.

DAVIS, W. C., Draftsman, Hughes Aircraft, Culver City.

FEY, R. M., Jr. Proj. Engr., Owens-Illinois Glass Co., Oakland.

FILIOS, P. S., Sales Engr., Natural Gas Equipment, Inc., South San Francisco.

FINLEY, R. W., Jr., Sales Engr., Minneapolis-Honeywell Regulator Co., Los Angeles.

GIBSON, R. Z., Jr., Mgr., Gibson Sheet Metal Works, Sacramento.

HAGLER, A. M., Mech. Engr., Santa Ana.

HARWOOD, R. S., Chief Engr., Tuttle & Bailey Pacific, Inc., La Puente.

HEIM, R. D., Sales Engr., L. J. Prues & Assocs., Los Angeles.

ISAAC, R. M., Sales Engr., English & Lauer, Inc., Los Angeles.

KONUK, FARUK*, Chief Mech. Engr., Pereira & Luckman, Los Angeles.

MACFARLAND, R. H., Sales Engr., Minneapolis-Honeywell Regulator Co., San Francisco.

MATLOCK, D. H., Sect. Engr., Mech. Sect., City & County of San Francisco, Bureau of Engrg., San Francisco.

MORSE, C. G., Partner, Kamor Engineering, Inc., Pasadena.

PRUES, L. J., Pres., L. J. Prues & Assocs., Los Angeles.

RODRIGUEZ, XAVIER, Design Engr., Air Conditioning Co., Inc., Glendale.

STOCKWELL, R. E., Teacher, Mech. Engrg., Sacramento Junior College, Sacramento.

WATERMAN, HAROLD, Engr., Climate Conditioning Co., Los Angeles.

District of Columbia (*Region* 5)

HUGHITT, J. K., A-C. Repr., Washington Gas Light Co., Washington.

WASHBURN, D. E., Asst. Military Br. Head of Code 549, Bureau of Ships, U.S. Navy, Washington.

Florida (*Region* 5)

KODATT, FRANK, Vice Pres., Conditiondaire, Inc., Jacksonville.

MCILVAINE, V. C., Pres. & Mgr., Conditiondaire, Inc., Jacksonville.

Georgia (*Region* 5)

ASKUE, W. R., Sr., Chief A-C Estimating Engr., Huffman Wolfe Southern Corp., Atlanta.

MINGLEDORFF, W. L., Jr., Pres., Mingledorff's, Inc., Savannah.

PITMAN, R. D., Dir. of Indus. Sales, Savannah Gas Co., Savannah.

SECKINGER, M. O., Jr., Owner, M. O. Seckinger Co., Savannah.

Illinois (*Region* 2)

BRENT, R. S., Dist. Engr., J. F. Pritchard & Co. of California, Chicago.

GOSPODARCZYK, S. F., Designing Draftsman, The Haines Co., Chicago.

LASAK, E. M.†, Chief Test Engr., Dole Refrigerating Co., Chicago.

REICHERT, G. L., Supvsrg. Engr., Northwestern University, Evanston.

Indiana (*Region* 2)

GREINER, P. C., Sr. Engr., Indiana & Michigan Electric Co., Fort Wayne.

RICHARDSON, JEROME, JR., Cons.-Owner, Loogootee.

STUNKARD, R. M., Treas., Paul R. Jordan & Co., Inc., Indianapolis.

Iowa (*Region* 3)

BEEBE, R. E., Sales Engr., B. J. Lutz, Inc., Des Moines.

Kansas (*Region* 3)

SJOLANDER, A. C., Physical Testing Engr., Gustin-Bacon Mfg. Co., Kansas City.

Kentucky (*Region* 5)

BOHANNON, H. J., Jr., Chief Draftsman, Southern Engineering Co., Louisville.

Louisiana (*Region* 5)

HODGDEN, W. F., Sales Engr., ILG Electric Ventilating Co., New Orleans.

LA BARBERA, ANTHONY, JR., Office Engr., A-C & Refrig., A. M. Lockett & Co., Ltd., New Orleans, La.

STONE, S. P., Jr.†, Engr., Sam P. Stone, Jr. & Assoc. & Bedell-Nelson, Inc., New Orleans.

WEATHERBY, F. E., Repr., Eggelhof Engineers, Inc., New Orleans.

Massachusetts (*Region* 1)

POLISNER, LEE, Gen. Sales Mgr., Burkhart Engineering Associates, Inc., Boston.

THEROUX, Q. O.*, Chief Engr. & Vice Pres., Boston Air Conditioning Co., Somerville.

Michigan (*Region* 2)

SPANGENBERG, A. C., Jr., Br. Mgr., ILG Electric Ventilating Co., Detroit.

Minnesota (*Region* 3)

JESTER, J. H.*, Br. Sales Mgr., Minneapolis-Honeywell Regulator Co., Minneapolis.

KENT, T. B., Jr., Sales Engr., Robar, Inc., St. Paul.

REEDY, S. V., Sales Engr., Johnson Service Co., Minneapolis.

SJORDAL, J. E., Sr. Engr., McQuay, Inc., Minneapolis.

Montana (*Region* 3)

DORSEY, H. T., Cons. Engr., Billings.

HANSON, H. S., Partner, Drapes Engineering, Billings.

New Jersey (*Region* 1)

BATTANI, R. A., Sales Engr., Powers Regulator Co., Springfield.

BRIEF, R. S., Indus. Hygienist, Esso Research & Engineering Co., Linden.

MARTIN, M. D., JR., Dist. Mgr., John J. Nesbitt, Inc., East Orange.

NEUMAN, ALLEN, Treas., S. Franklin & Sons, Inc., Newark.

STAATS, W. J., Co-Owner, West Jersey-York, Inc., Merchantville.

VEKONY, A. J., Br. Mgr., John J. Nesbitt, Inc., East Orange.

New Mexico (*Region* 6)

WALLER, B. M., Mech. Engr., E. T. Kryfko, Albuquerque.

New York (*Region* 1)

BECKER, H. E., Sales Repr., Weil-McLain Co., Castleton.

CHARLEBOIS, J. L., Appl. Engr., Carrier Corporation, Syracuse.

DUNBAR, J. N., Mech. Supvsr. (Field) Voorhees, Walker, Smith & Smith, New York.

ELLIOTT, W. S., Sales Engr., Gustin-Bacon Manufacturing Co., New York.

ENGLUND, H. M., Asst. Editor, The Industrial Press, A-C., Heating & Ventilating, New York.

JACOB, W. I., Sales Engr., American Blower Division, American-Standard, New York.

KORAL, R. L., Asst. Editor, The Industrial Press A-C., Heating & Ventilating, New York.

KUKLIS, T. W., Sales Engr., Dunham-Bush, Inc., New York.

McINTOSH, GEORGE, Bldg. Operations Engr., Long Island Lighting Co., Hicksville.

SAUNDERS, M. K.*, Pres., Kerby Saunders, Inc., New York.

SCOTT, C. V., Sales Engr., American Blower Division, American-Standard, New York.

SIMMONS, RALPH, Owner, Ralph Simmons Co., Kenmore.

SPRAGUE, F. J., Dist. Repr., Bell & Gossett Co., Albany.

WALSH, E. J., Sales Engr., American Blower Division, American-Standard, New York.

North Carolina (*Region* 5)

POPLIN, C. B., JR., Mech. Engr., Watson & Hart, Greensboro.

North Dakota (*Region* 3)

GALVIN, W. J., Mech. Designer, Wells & Denbrook, Grand Forks.

Ohio (*Region* 2)

HALVERSTADT, R. K., Chief Mech. Engr., McGeorge-Hargett & Assocs., Cleveland.

HAYES, J. C., Br. Mgr., Service Products, Inc., Toledo.

KUSANKE, R. W., Proj. Engr., Avery Engineering Co., Cleveland.

LIEBERT, J. W., Engrg. Supvsr., Capitol Refrigeration Co., Columbus.

MUIR, R. D., Sales Engr., Minneapolis-Honeywell Regulator Co., Columbus.

POUNTNEY, C. H., JR., Dir. of Research, Viking Air Products, Cleveland.

URBAN, R. A.*, Partner, John Paul Jones, Cary & Millar, Cleveland.

Oklahoma (*Region* 6)

DURDEN, H. D., Prom. Salesman, Crane Co., Tulsa.

MOORE, W. H., Chief Engr. & Asst. Bldg. Supt., Station KVOO, Tulsa.

NICHOLS, J. K., Engr., Natkin & Co., Tulsa.

PALMER, R. W., Pres., Palmer Supply Co., Tulsa.

SMITH, S. W., Repr., Crane Co., Tulsa.

WRIGHT, ELMER, Htg. Promotional, Crane Co., Tulsa.

Pennsylvania (*Region* 1)

CAUM, T. L., Pres., Caum Engineering Corp., Altoona.

CHANEY, C. K., Repr., Allis-Chalmers Manufacturing Co., Inc., Philadelphia.

CRAW, V. E., Draftsman-Designer, Caum Engineering Corp., Altoona.

CUSTER, A. R., Plbg., Htg., & A-C. Repr., Amstan Supply Div., American-Standard, Johnstown.

MAKDAD, E. C., Owner, Allen Supply Co., Altoona.

WIND, M. J., Regional Service Mgr., Carrier Corporation, Phila.

Tennessee (*Region* 5)

WILBANKS, C. C., Sales Engr., Westinghouse Electric Co., Memphis.

Texas (*Region* 6)

ARNOLD, H. L., Pres., H. L. Arnold Co., Inc., Austin.

BIERING, R. O., JR., Partner, Blase & Co., San Antonio.

JOHNSON, J. L., Owner, Jas. L. Johnson Co., Dallas.

PATTON, R. L.*, Br. Com. Mgr., Minneapolis-Honeywell Regulator Co., Dallas.

Washington (*Region* 4)

MURPHY, R. L., Pres., Liberty Equipment & Supply Co., Seattle.

SMITH, R. J., Mech. Engr., Bouillon & Griffith, Seattle.

Canada (*Region* 7)

ABUGOV, JACK, Owner, Abugov & Sunderland, Calgary, Alta.

BERUBE, ROLLAND, Sales Mgr., Eastern Div., The Coleman Lamp & Stove Co., Ltd., Town of Mt. Royal, Que.

BLAIR, D. M., Asst. Sales Mgr., Darling Brothers, Ltd., Montreal, Que.

DARLING, D. A., Appl. Engr., Darling Brothers, Ltd., Montreal, Que.

GOODRIDGE, A. F., Vice Pres., Snyder & Boon, Ltd., Calgary, Alberta.

HOLDEN, J. C.*, Cons. Engr., Westmount, Que.

JACK, W. W., In Charge Com. A-C., Installation, Reggin Roofing & Sheet Metal Works, Ltd., Calgary, Alta.

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NARFASON, G. T., Sales Engr., Trane Co. of Canada, Calgary, Alta.

ONTONIO, L. D.*, Br. Mgr., Trane Company of Canada, Ltd., Calgary, Alta.

PEACOCK, W. B., Engr., Duby Engineering Associates, Ltd., Edmonton, Alberta.

PRINGLE, N. A., Htg. Supt., Fred Welsh & Son, Ltd. Vancouver, B. C.

REGGIN, O. A., Mgr., Reggin Roofing & Metal Works, Ltd., Calgary, Alta.

ROBERTS, STANLEY, Htg. Estimator & Designer, Reggin Roofing & Metal Works, Ltd., Calgary, Alta.

SMITH, J. D., Assoc., D. M. Drake, Vancouver, B. C.

WARRING, G. R., Sales Engr., Sheldons Engineering, Ltd., Montreal, Que.

WILLIS, A. V., Dir., F. H. Lepper & Co., Ltd., Calgary, Alta.

Arabia

BARAKAT, N. A. R., Head, A-C., Htg.-Vtg. Section, Kuwait Government, Kuwait.

Australia

HOGG, F. R., Vtg. Foreman & Estimator, Frederick W. Nielson, Moorabbin, Victoria.

Cuba

MARBAN, JOSE, Designer, Manzanillo, Oriente.

OBITUARIES

GUSTAV A. DORNHEIM
New York, N.Y.

Gustav A. Dornheim, 72, a vice president of Buensod-Stacey, Inc., New York, N.Y., died on September 22. Mr. Dornheim, a member of the New York Chapter, was honored by Life Membership in the Society in 1950.

Mr. Dornheim, who was born in New York, N.Y., started in the heating and ventilating industry in 1903 as an office boy with the Frank Dobson Co. He gained further experience in the employ of Thompson-Starrett Co., Long Island City, as estimator and engineer in the mechanical department and later in charge of the Heating and Ventilating Division.

He became affiliated with Voorhees, Gmelin & Walker in 1934. Mr. Dornheim also spent three years as mechanical engineer with the New York City Department of Hospitals. In 1939 he joined Buensod-Stacey, specializing in piping for heating, ventilating and air conditioning.

An active member of the New York Chapter, Mr. Dornheim served on the board of governors in 1918-19 and again in 1920-21. He was a licensed professional engineer in the State of New York.

ROBERT L. DRYER
Seattle, Wash.

Robert Lewis Dryer, 48, partner and mechanical engineer, Pacific Engineers, Seattle, Wash., died in the hospital on September 6, after a short illness.

Mr. Dryer started his career with the Washington State Highway Department as a draftman. For many years he served as mechanical engineer for W. C. Nickum & Sons, Seattle. In 1953, he was named senior design engineer, Boeing Airplane Co. He assumed the position with Pacific Engineers just last year.

In addition to his ASHAE affiliation, Mr. Dryer was a member of the *Pacific Coast Gas Association* and was a registered engineer in the State of Washington. He was a member of the Sand Point Community Church and Masonic Lodge.

Surviving are his wife, Gail; two daughters, Susan Dryer, Seattle, and Mrs. Marianne Connell, Pasco, Wash.

ROBERT R. TALIAFERRO
Lexington, Ky.

Robert R. Taliaferro, 80, a Life Member of the Society for the past ten years, died on September 13. He had been ill for a few months and was hospitalized at the time of his death.

Mr Taliaferro, who was born in Newtown, Va., received his B.M.E. from the University of Kentucky in 1913. After graduation, he was associated with Buffalo Forge Co., Buffalo, N.Y. For many years thereafter he was affiliated with Carrier Corporation, covering a great range of work in air-conditioning and refrigeration design, development, sales, installation, supervision, testing and control.

Leaving Carrier in 1943, he became a mechanical engineer for the National Advisory Committee on Aeronautics at their Aircraft Engine Research Laboratory, Cleveland Airport, Cleveland, Ohio, in the operation of a refrigeration and air-conditioning plant. He retired from this position in 1954.

He is survived by his wife, Maybelle, who resides at their home in Lexington.

(For most recent listing of Society officers and committee personnel see Frontispiece, JOURNAL SECTION)

Committee on Research and Its Technical Advisory Committees

The research program of the Society is under the guidance of the Committee on Research — a General Committee — elected by the vote of Society membership. That Committee appoints Technical Advisory Committees as necessary and directs their activities. Listed below are the names of the current members of these committees.

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Buena Vista College
Storm Lake, Iowa

St. Monica Parish Church
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Purdue University
W. Lafayette, Indiana

Wm. S. Speed Building
University of Louisville
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Elementary School
Phoenix, Arizona

Lodi High School
Lodi, California

McKinley School
Bakersfield, California

St. John the Baptist School
Chico, California

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Dallas, Texas

Southeastern College
Hammond, Louisiana

Trinity Episcopal Church
Lawrence, Kansas

Our Lady of Fatima Shrine
South Bend, Indiana

Sardis Presbyterian Church
Charlotte, North Carolina

Theodore Roosevelt School
Indio, California

St. Peter & Paul Parish
Turkey Creek, Indiana

Belle Isle Elementary School
Oklahoma City, Oklahoma

Eunice Smith School
Alton, Illinois

Holy Name Elementary School
Cook, Indiana

University of Pennsylvania
Philadelphia, Pennsylvania

Swarthmore College
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Immaculate Heart of Mary Parish
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Already, more than 100 schools have planned for it—by installing HerNel-Cool II

Nearly every school would benefit from air conditioning as have offices, theaters, hospitals and homes. In fact, many new schools *are* air conditioned, or have prepared for it—by installing HerNel-Cool II unit ventilators. *This Herman Nelson product is the first unit ventilator to offer optional air conditioning,* as well as heating, ventilating and natural cooling (with outside air).

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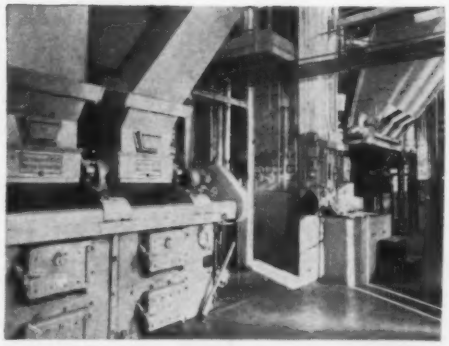
takes fuel costs for a ride

With increased fuel efficiency, Carlisle Tire and Rubber burns coal . . . holds costs to minimum while upping production 20%

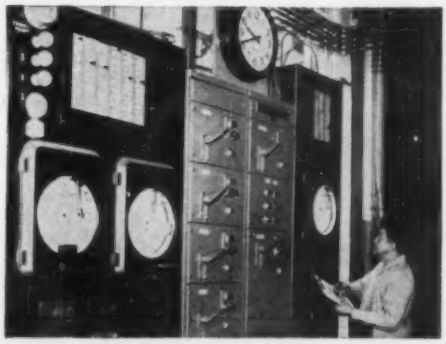
At the Carlisle Tire and Rubber Division of Carlisle Corp., Carlisle, Pa., the steam produced by the power plant is used primarily for processing. As production of bicycle tires, inner tubes and other rubber products increased, the firm's engineering department decided to boost steam capacity with modern coal-burning facilities. Coal was used on the basis of cost—25% less than the nearest competitive fuel. The result has been a dependable steam supply, cleanliness of operation and a jump in operating efficiency. Today the plant consumes the same tonnage of coal as before modernization although production has increased 20%!



Firing aisle of Carlisle's power plant. Left foreground is new 20,000 lbs./hr. boiler by E. Keeler Co., fired by Detroit Rotostokers. In the rear is an Erie City Water Tube Boiler (equipped with Erie City Spreader Stokers), used as stand-by unit.

Facts you should know about coal

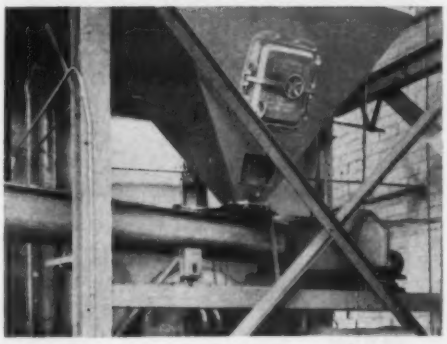
Not only is bituminous coal the lowest-cost fuel in most industrial areas, as in the case of Carlisle, but up-to-date coal burning equipment can give you 10% to 40% more steam per dollar on the average. Today's automatic equipment pares labor costs and eliminates smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.



Close-up of control panel, by Hagan Corp. These controls—regulating furnace draft, steam flow, air flow, flue gas temperature, stoker control—constitute a complete, automatic combustion control system.

Technical advisory service

The Bituminous Coal Institute offers a free technical advisory service on industrial fuel problems. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send the coupon below for our case history booklet, complete with data sheets. You'll find it informative.



Fly ash is collected by this Prat-Daniel Mechanical Precipitator. Fly ash is gravity-fed from the hopper (at top of photograph) into completely-enclosed screw conveyor which moves it cleanly to the disposal point.

Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—will effect great savings for you in efficiency and fuel economy over the years.

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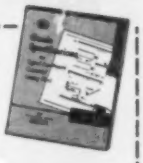
The Bituminous Coal Institute now has available a free booklet, "Guide Specifications for Typical Low-Pressure Commercial Heating Plant," containing specifications, drawings and tables on all aspects of a typical heating plant. Send in this coupon for your copy.



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AIRCOUSTAT SILENCES ALL FREQUENCIES IN THE AUDIO-FREQUENCY RANGE
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Since 1925, TRANE has pioneered in developing and improving radiation products. Now the broadest, most complete line in the industry, TRANE offers you everything you need for any radiation job—whether it's a single room or hallway, or the largest school or hospital. And when you turn to TRANE, you simplify procurement, pinpoint responsibility for *all* your radiation needs.

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- Element glides silently on ball-bearing cradles for free expansion without strain on enclosure.
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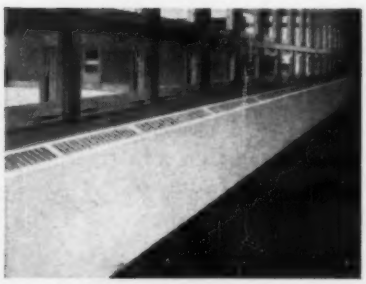

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TRANE Wall-Line Convectors are designed for relatively short runs and very high capacity—providing attractive, modern wall-to-wall installations in schools, office buildings, hospitals and institutions. Compact and rugged construction, with extra reinforcements and full back.

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Rugged construction with frame for both sides of door. Telescoping design shown below permits use with doors from 1¾" to 2" thick.

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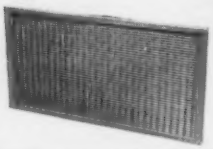
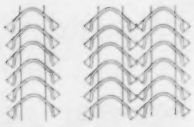
In specific sizes to meet individual requirements, and convenient stock sizes which may be custom-cut by the contractor.
UNI-FLO MODEL AF GRILLE, below, has simple U-Moulding.





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Core cross section at left shows Uni-Flo Sight-Tite Grille. Cross section at right shows Light-Tite installation for photographic darkrooms and laboratories.

Handsome and strong Uni-Flo Sight-Tite Door Grilles provide free air movement for offices, dressing rooms, locker rooms, school rooms, and other areas, without unsightly "see-through" gaps. Because of their inherent extra strength, Uni-Flo Sight-Tite Door Grilles withstand scuffing and kicking. Rattleproof construction also contributes to a finer installation. Available with six standard baked enamel and electroplated finishes, or special baked enamel finishes to match any color. With frame, or as core alone, in wide range of sizes to meet your job requirements. See your nearest Barber-Colman Field Office, or write for catalog.

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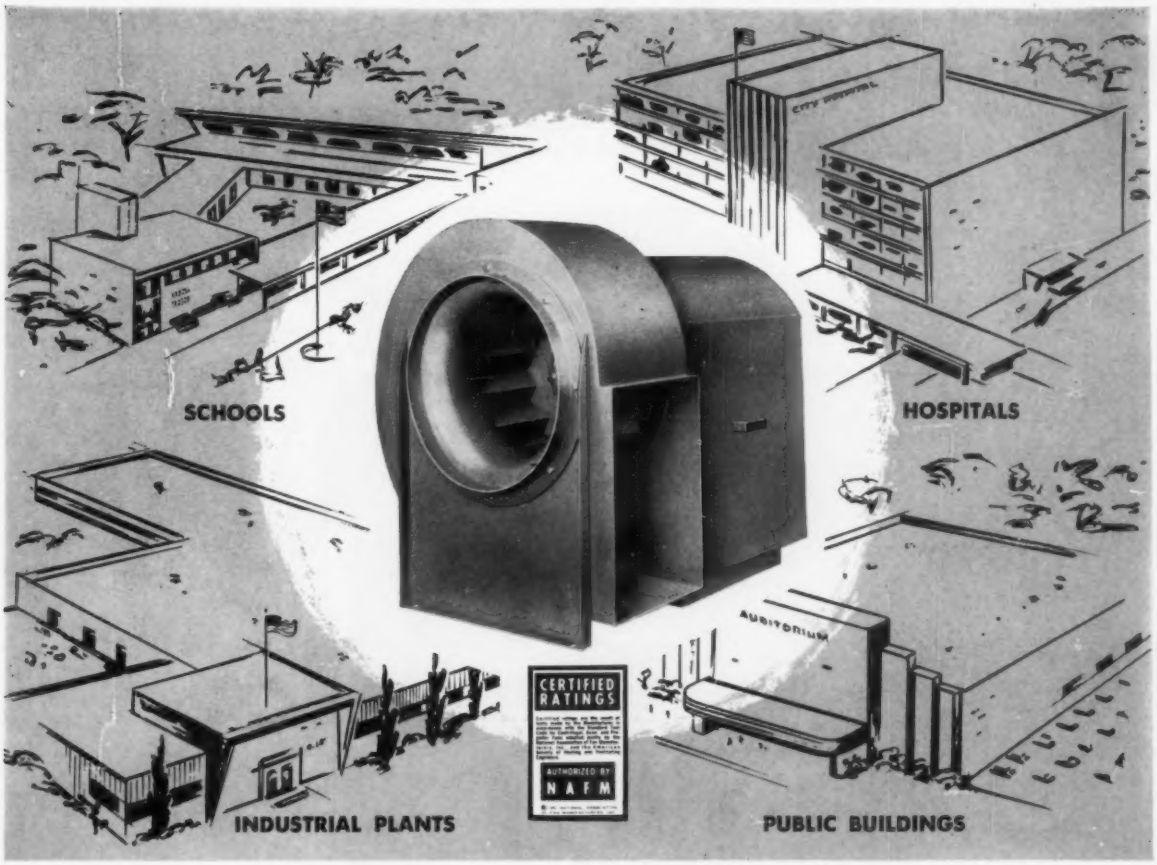

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Peerless blowers meet and excel industry standards. They have been thoroughly tested according to test codes. Thousands of them are providing economical, continuous ventilation in installations all over the country.

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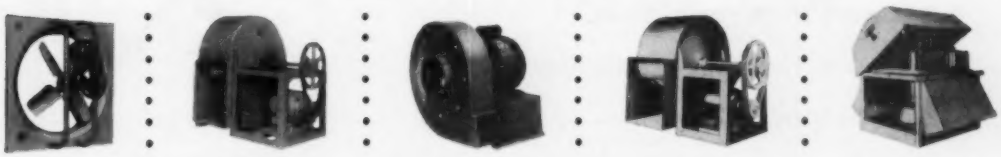

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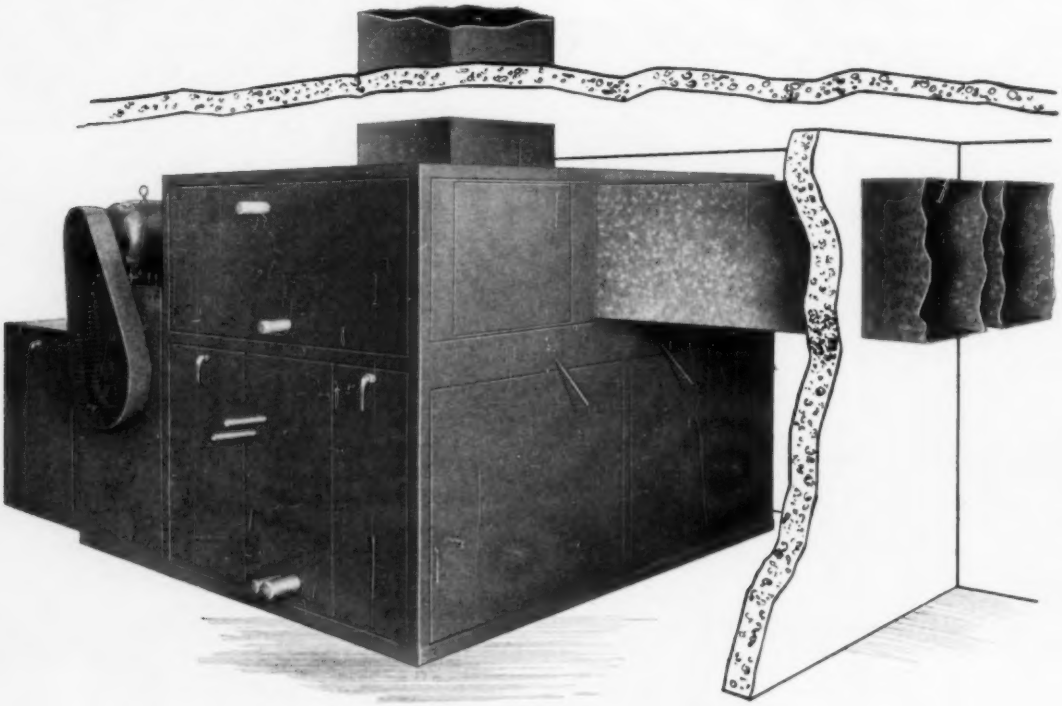
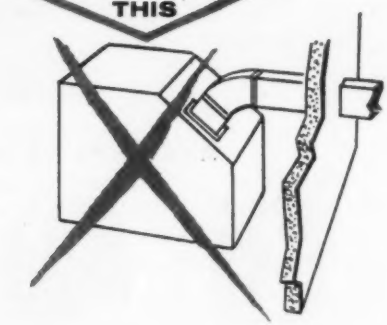
KENNARD *Engineered* MULTI-ZONE AIR CONDITIONING UNITS



THIS

Save 45° Turns

NOT THIS



Duct openings available horizontal or vertical in any combination . . . run risers or laterals straight from unit without transitions.

Lowers sheet metal costs.

Reduces duct static resistance.

Saves space.

Write for name of nearest representative and copy of Catalog No. MZ-2.

KENNARD CORPORATION
1817 HANLEY RD. • ST. LOUIS 17, MO.

in easy-to-handle **dry** form

Cleaners based on Du Pont Sulfamic Acid are safer, more convenient, non-fuming . . . dissolve in water to form effective, low-corrosive solutions

Now . . . powerful acid cleaners you handle *dry* with no hazardous fumes, no acid splashing! When added to water, these cleaners form solutions equal to hydrochloric acid in penetrating power, yet they're far less corrosive. The key to these unusual properties is Du Pont Sulfamic Acid.

Cleaners based on sulfamic acid cut downtime to a minimum during scale removal. In many situations, because there are no fumes, cleaning can be done with no interference to normal operations. And, because these cleaners are easier to handle and store, their use results in lower labor and storage costs.

We'll gladly send you additional information on sulfamic acid-based cleaners, and the name of formulators who offer these new compounds. Just mail the coupon below.

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E. I. du Pont de Nemours & Co. (Inc.)
Grasselli Chemicals Dept., Room N-2533
Wilmington 98, Delaware

Please send me ☐ sulfamic acid general equipment cleaning bulletin; ☐ air conditioning bulletin; ☐ names of formulators offering cleaners based on Sulfamic Acid.

*Name*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

NEW IMPROVED

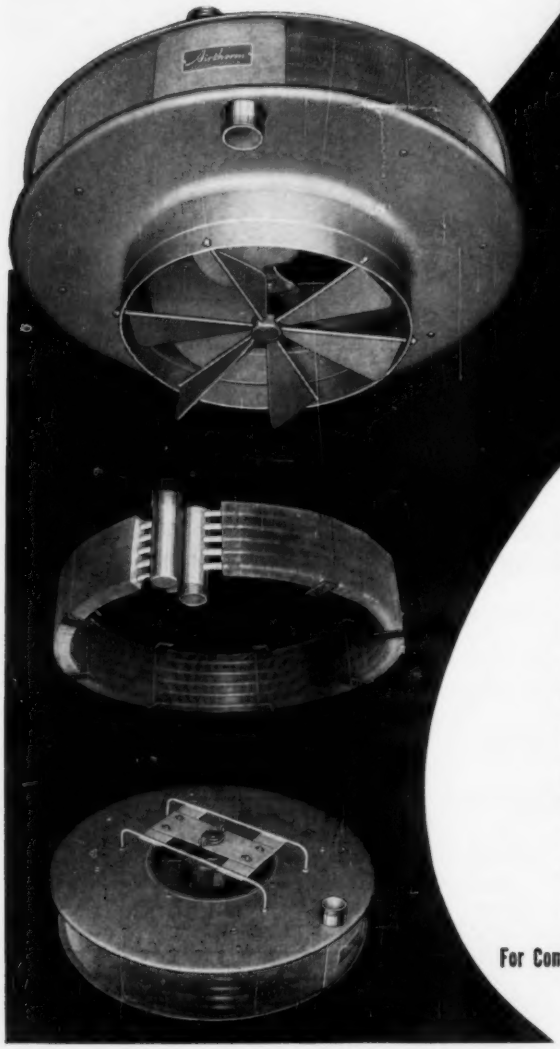
Airtherm

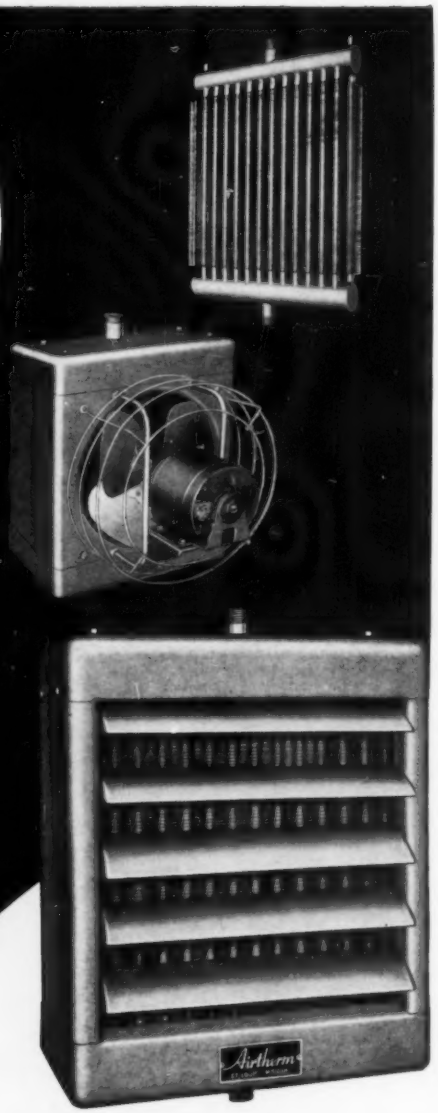
PROPELLER FAN

UNIT HEATERS

FOR STEAM OR HOT WATER

A SIZE FOR EVERY REQUIREMENT



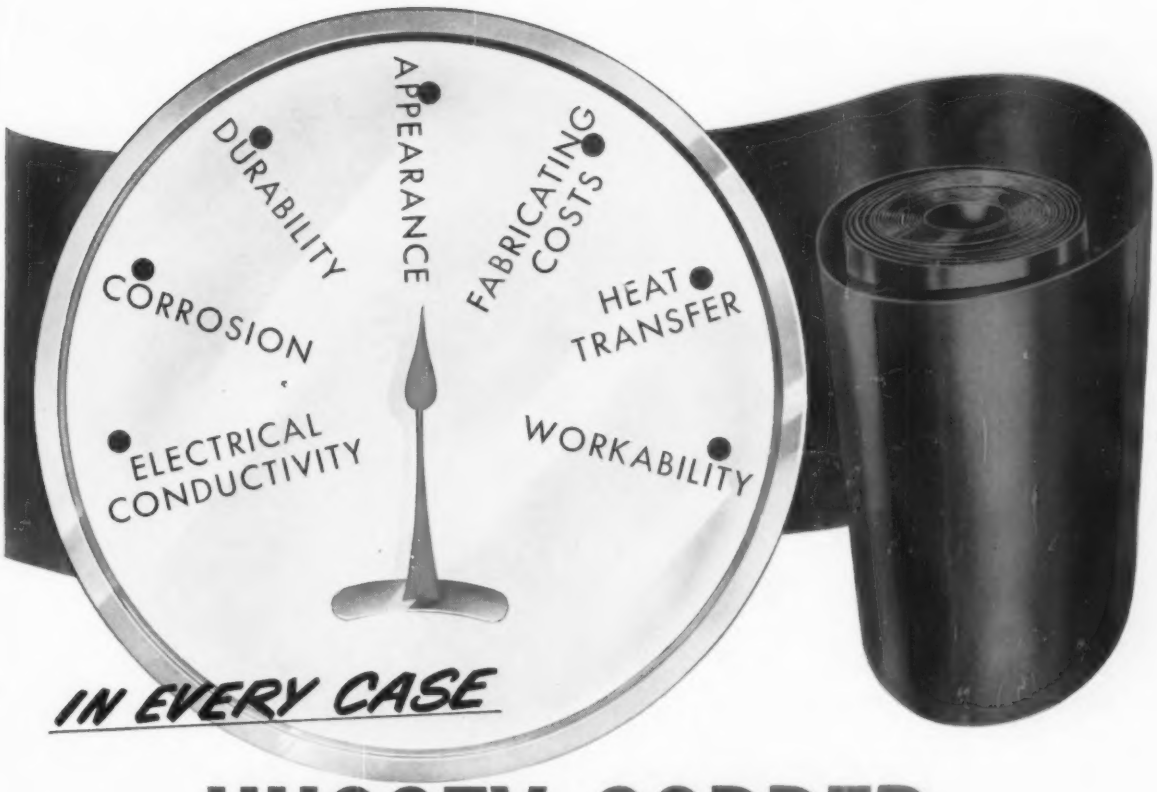


The new Airtherm line incorporates 22 completely redesigned vertical units and 24 improved horizontal units, ranging from 18,000 to 555,000 BTU per hour, with a choice of outlet diffusers to cover practically every air distribution pattern and mounting height. Silent operation is assured by resiliently mounted motors, properly designed fans and casings, and attention to face and outlet velocities. All fans are expertly positioned, balanced and tested. Each unit is tested and rated for performance in strict accordance with the Standard Test Code of the industry. Only brand name, continuous duty motors, especially made for the purpose, are used and mountings are designed for efficient cooling and easy servicing. Rugged coils are formed by hydraulically expanding copper tubing into plate type aluminum fins, each with its own collar, providing increased heat transfer and wide, even spacing to reduce clogging. All coils are tested and tagged for 500 p.s.i. hydrostatic pressure. Casings are phosphatized to insure a long, rust-free life for the attractive baked enamel hammer tone finish.

For Complete Specifications Including a Guide for Selection and Application, Write:

AIRTHERM MANUFACTURING CO.

702 S. SPRING AVE. • ST. LOUIS 10, MO.



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IS INDICATED FOR YOUR PRODUCT

Select the production or service characteristic your product requires and you'll find HUSSEY COPPER exactly fills the bill.

If production is a problem, rely upon the extreme ease of cutting, forming, stamping or spinning Hussey Copper and your choice of lock seaming, soldering or brazing for assembly. Consider, too, the smooth surface and bright finish on Hussey Copper that can save you many finishing operations.

All these "work-savers" mean faster production, fewer and less complicated fabrication operations and minimum finishing.

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WORLD'S FIRST BRONZE SKYSCRAPER HAS CHICAGO "FLUSH KLEEN"® SEWAGE PUMPS

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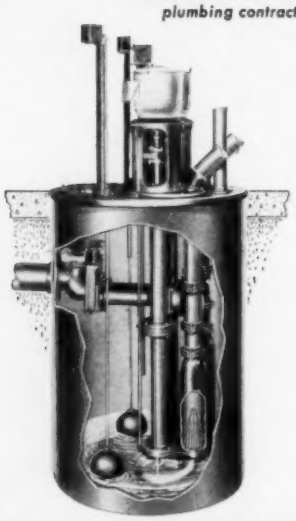

"FLUSH KLEEN"® Sewage Pump . . . Automatically Backwashes Strainer . . . Strainer Keeps Solids From Basin and Pump . . . Water Only Handled By Impeller.

• The new 375 Park Avenue Building, New York, literally has EVERYTHING— and *everything* is QUALITY. Quality ideas, plans, materials and workmanship have provided such modern conveniences as year-round peripheral zoned air conditioning with balanced humidity and finger-tip control, 18 electronically controlled high-speed elevators, closed circuit color television, special non-glare exterior glass walls, etc. Chicago "FLUSH KLEEN"® Sewage Pumps have provided for continuous, trouble-free waste disposal service.

More than 12,000 Chicago "FLUSH KLEEN"® Sewage Pumps have been installed as standard equipment in fine buildings everywhere — and NOT ONE HAS EVER CLOGGED. Only liquid reaches the pump impeller. There is no contact between the pump's working parts and coarse sewage material.

This is why Chicago Pump Company "FLUSH KLEEN"® Sewage Pumps have an unequalled record of clog proof performance and are preferred throughout the building industry.

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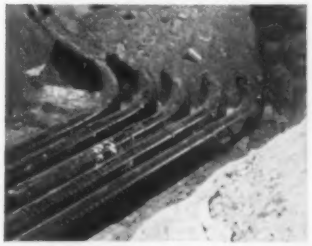
Look what you can do with "SCOTCHRAP"!

54-INCH circulating water lines are easily protected against corrosion by wrapping with wide-width "SCOTCHRAP." Tape is clean, easy, safe to use; no heat or special equipment necessary.

QUICK, easy application of "SCOTCHRAP" to long lines of welded pipe expedited by use of Betzel "Tapester." Permits continuous insulating with smooth, tight result.



TOUGH "SCOTCHRAP" easily withstands abrasions of rough fill. In event of tearing or accidental rupture, simple patch repairs the damage. For further information, write 3M Co., St. Paul 6, Minn., Dept. PD-127.

Sticks at a touch to curves and contours

Irregular fittings on small pipes of mixed diameters are easily wrapped with the proper widths of "SCOTCHRAP." This smooth, tough tape conforms tightly to elbows, flanges, and welded beads, as well as long lengths in all diameters. Pressure-sensitive "SCOTCHRAP" is super-strong polyvinyl chloride plastic tape in rolls. Available in seven standard widths from 1 to 18 inches. "*The quality pipe protection that rolls on dry.*"

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The term "SCOTCHRAP" is a registered trademark of Minnesota Mining and Manufacturing Co., St. Paul 6, Minn. Export Sales Office: 99 Park Ave., New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

PRODUCT OF 3M COMPANY RESEARCH

JENKINS PRACTICAL PIPING LAYOUTS

79

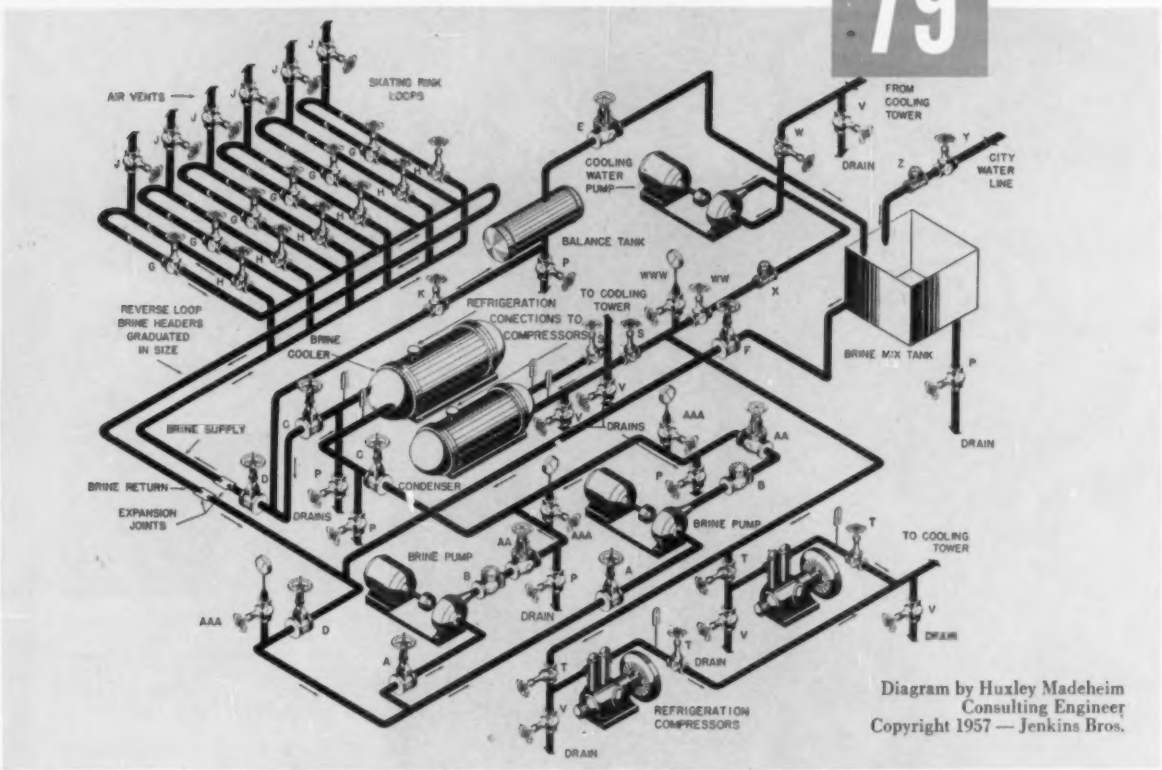


Diagram by Huxley Madeheim
Consulting Engineer
Copyright 1957 — Jenkins Bros.

How to plan piping for

AN ARTIFICIAL ICE SKATING RINK

In the increased construction of skating rinks during recent years, a closed system with a balance tank located at its highest point has been commonly installed. The piping layout presented here utilizes such a system.

This system is suitable for any of the common brines. Calcium chloride brines are the most common, but others of a non-corrosive nature are frequently used. The cooling medium, which is circulated in the rink coils to freeze the water into ice, is usually chilled by a multiple Ammonia or Freon refrigeration installation like the system in the diagram. Coils carrying the ice-making brine are generally 1" or 1¼" iron or steel pipe on 4" centers, with welded connections. Each coil loop is shown with a globe valve for control and shut-off at one end. A gate valve provides for shut-off and complete isolation of the individual coil at the other end. Each coil has an air vent.

Either or both of the two brine pumps may be used, depending on specific conditions and requirements. In addition to the brine circuit, the cooling water circuit to the condenser and compressors is diagrammed. Ordinarily, valves in this cooling water circuit are bronze or iron body bronze mounted.

For systems handling corrosive brines, such as calcium chloride, all-iron valves are specified. For systems using non-corrosive brines, bronze or iron body bronze mounted valves are recommended.

Where gate valves are specified for shut-off services, rising spindle types, which indicate wedge position, have been chosen.

The sturdy Jenkins Fig. 241 O.S. & Y. U-Bolt all-iron gate, is favored by engineers and contractors for corrosive brine systems. *Jenkins Fig. 106-A* renewable composition disc bronze globe valve is recommended for installation on individual coils, brine coil air vents, and for other regulatory services where accurate flow control and drop-tight closure are essential.

To assure efficiency in the job when planning any major piping installation, consult with accredited piping engineers and contractors, and select your valves from the Jenkins Catalog.

Enlarged diagram and full description of this layout No. 79 free on request to Jenkins Bros., 100 Park Ave., New York 17.

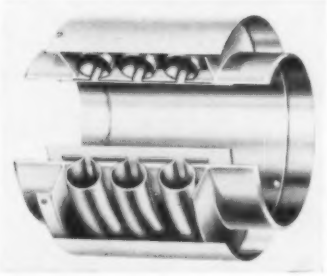
		Non-Corrosive Brines	Corrosive Brines	
Code	Quan	Jenkins Valves	Jenkins Valves	Service
A	2	Fig. 651 A IBBM	Fig 241 All Iron Gate	Brine pump flow shut off
AA	2	Fig. 142 IBBM	Fig 81 All Iron Globe	Brine pump flow control
AAA	3	Fig. 106-A Bronze	Fig. 75 A All Iron Globe	Brine pump pressure gauge
B	2	Fig. 624 IBBM	Fig. 85 All Iron Swing Check	Prevent backflow through brine pump
C	2	Fig. 651 A IBBM	Fig. 241 All Iron Gate	Shut off chiller brine flow
D	2	Fig. 651 A IBBM	Fig. 241 All Iron Gate	Brine to rink shut-off
E	1	Fig. 142 IBBM	Fig. 81 All Iron Globe	Brine balance tank overflow control
F	1	Fig. 651 A IBBM	Fig. 241 All Iron Gate	Brine flow shut-off at tank
G	(1 each)	Fig. 106-A Bronze	Fig. 75 A All Iron Globe	Control brine flow in individual coil
M	(1 coil)	Fig. 47 U Bronze	Fig. 240 All Iron Gate	Shut-off brine flow in individual coil
J	(1 coil)	Fig. 106-A Bronze	Fig. 75 A All Iron Globe	Control brine coil air vents
K	1	Fig. 106-A Bronze	Fig. 81 All Iron Globe	Brine balance tank flow control
P	6	Fig. 106-A Bronze	Fig. 75 A All Iron Globe	Control brine drains

Code	Quan	Jenkins Valves	Service
S	2	Fig. 47 U Bronze Gate	Shut off condenser cooling water
T	4	Fig. 47 U Bronze Gate	Shut off compressor cooling water
V	6	Fig. 106-A Bronze Globe	Control fresh water drains
W	1	Fig. 47 U Bronze Gate	Cooling water pump flow shut-off
WW	1	Fig. 106-A Bronze Globe	Cooling water pump flow control
WWW	1	Fig. 106-A Bronze Globe	Cooling water pump pressure gauge control
X	1	Fig. 92 A Bronze Swing Check	Prevent backflow through cooling water pump
Y	1	Fig. 106-A Bronze Globe	Control water supply makeup
Z	1	Fig. 92 A Bronze Swing Check	Prevent backflow into water supply

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
TRADE JENKINS MARK SINCE 1864
Jenkins Bros
Sold Through Leading Distributors Everywhere

EQUIPMENT DEVELOPMENTS . . .

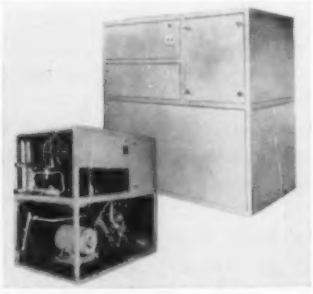
For reviews of Recent Trade Literature see Page 220



Expansion Joints . . .

. . . for high pressure, high temperature service — *Zallea Bros., Dept. HPAC, 815 Locust St., Wilmington 99, Del.*

Units protect power, process piping systems, related equipment against damage from expansion, contraction due to temperature change. Toroidal corrugations have circular or oval cross sections which produce low operating stresses, manufacturer says. Made of stainless steel, available in 6 in. diameter sizes and larger for pressures to 2000 psi.



Air Conditioning Unit . . .

. . . for summer, winter use — *Dunham-Bush, Inc., Dept. HPAC, 179 South St., West Hartford 10, Conn.*

New "CPU" houses evaporator, compressor, evaporative condenser, fans, motors, refrigerant piping, controls. Unit also functions as evaporative condenser water saver. Available in 10, 15, 20, 30, 40 ton sizes.

Vertical Unit Heaters . . .

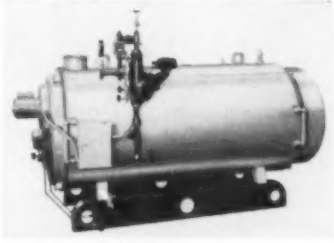
. . . in 22 models 42,300 to 555,000 Btu — *Airtherm Mfg. Co., Dept. HPAC, 711 S. Spring Ave., St. Louis.*

Units offered with choice of outlet diffusers to cover variety of air distribution patterns, mounting heights. Silent operation attributed to resiliently mounted motors, properly designed fans and casings, attention to face, outlet velocities, company says. All fans positioned, balanced, tested. Coils, tagged for 500 psi hydrostatic pressure, formed by hydraulically expanding copper tubing into plate type aluminum fins each with its own collar.

Electric Motor Operator . . .

. . . designed to control dampers in heating, ventilating, air conditioning systems — *Barber-Colman Co., Dept. HPAC, 1300 Rock St., Rockford, Ill.*

Motor features new type gear train and drive completely submerged in oil, sealed in die cast case. May be mounted in any position; auxiliary switches readily accessible; simple to adjust, company says. Enclosed spring return drives controlled device to its normal position on power interruption. Manufactured in 24, 115, 208, 230 volt ratings.



Packaged Boiler . . .

. . . for light, medium sized processing plants — *Cleaver-Brooks Co., Dept. HPAC, 326 E. Keefe Ave., Milwaukee 12.*

New automatic, 40 hp "Monitor" is 53 in. high, has vent that removes combustion gases from boiler room. Available through 60 hp or 2070 lb of steam per hr. Can be fired with oil or gas or furnished with combination burner, company says.

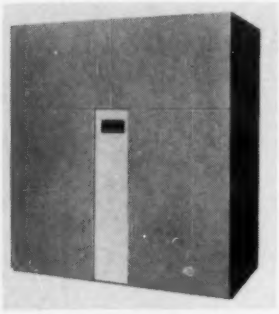
Induction Motor . . .

. . . designed to operate at exact synchronous speed without permanent magnets or d-c excitation — *Louis Allis Co., Dept. HPAC, 427 E. Stewart St., Milwaukee 1.*

"Syncro Spede" suitable for use in many applications requiring constant speed with varying load. Unit makes possible constant speed or adjustable speed system from no load to full load conditions with minimum of driving units and controls, company says. Manufactured in ratings 1 to 100 hp in any enclosure type; can be foot or flange mounted.

EQUIPMENT DEVELOPMENTS

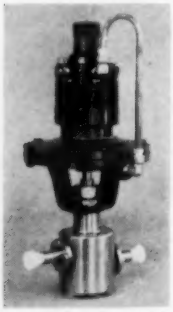
Continued



Air Conditioning Units . . .

. . . with 20, 25, 30 ton capacities — *General Electric Co., Air Conditioning Div., Dept. HPAC, 5 Lawrence St., Bloomfield, N. J.*

New 1958 floor mounted, water cooled units have exterior with simple lines. Models designed to be eye catching in appeal, offer efficient operation, manufacturer says. Air cooled 15, 20 ton units also available which may be used as split system with remote air cooled condensers, weatherproofed for outdoor installation.



Control Valve . . .

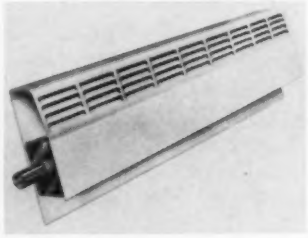
. . . designed to control flow of corrosive products — *George W. Dahl Co., Inc., Dept. HPAC, 86 Tupelo St., Bristol, R. I.*

Body, stuffing box, integral seat, internal ports of unit machined from solid block of teflon encased in stainless steel housing. Plug and stem are one, reinforced with stainless steel, company says. Spring loaded chevron rings engineered to maintain tight stem seal. Plug characterized, calibrated to meet requirements within ranges 0.003 minimum to 1.4 maximum Cv, with maximum rangeability 50 to 1.

Ultraviolet Lamp . . .

. . . designed to destroy bacteria, virus, molds — *Westinghouse Electric Corp., Dept. HPAC, Box 2278, Pittsburgh.*

"Sterilamp G10T5-½" may be inserted in heating, air conditioning ducts located in homes, schools, offices. Tests indicate that approximately 80 percent of air borne virus and bacteria are destroyed when lamp is installed, company says. Tube length including base pins is 14¾ in.; rated life for hot cathode is 7500 hr.



Baseboard . . .

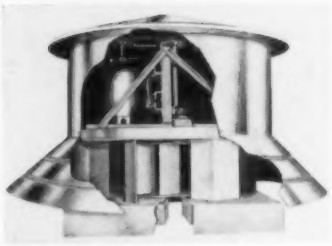
. . . designed for educational, commercial, industrial installations using hot water, steam — *Dunham-Bush, Inc., Dept. HPAC, 179 South St., West Hartford 10, Conn.*

"BFOT," which can be assembled by snapping components together, is slim, can be painted to harmonize with any color scheme, company says. Among other features cited by manufacturer: suitability for wall to wall carpeting; improved circulation of cold air from picture windows without heat loss; simplicity of cleaning. Units have heavy gage cover, angular louver grilles.

Combination Saw, Drill . . .

. . . designed to cut and drill steel, sheet metal, pipe, rod, tubing, fiber, plastic, wood, wall board — *Modern Mfg. Co., Inc., Dept. HPAC, 680 Davisville Rd., Willow Grove, Pa.*

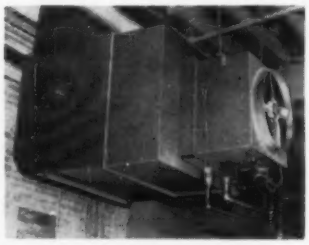
"Trades Master" can be converted from saw to drill by removing, inserting tool in chuck and shifting knob to drill or saw position. Current applied by pressing trigger switch. Accommodates drills to ¼ in.



Roof Exhauster . . .

. . . designed for applications, installations requiring minimum operating noise factor — *Chicago Blower Corp., Dept. HPAC, 9863 Pacific Ave., Franklin Park, Ill.*

Unit controls flow of air through exhauster keeping turbulence, discharge losses to minimum, manufacturer says. Backward curve type wheel features steep pressure curves, nonoverloading power characteristics. Unit said to produce vibrationless operations 830 to 29,750 cfm. Vibration eliminators of rubber float base at four points.



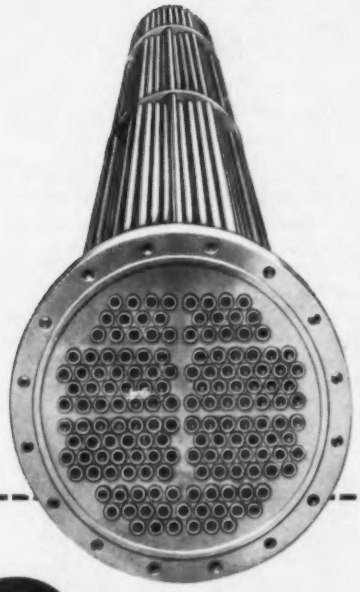
Air Makeup Unit . . .

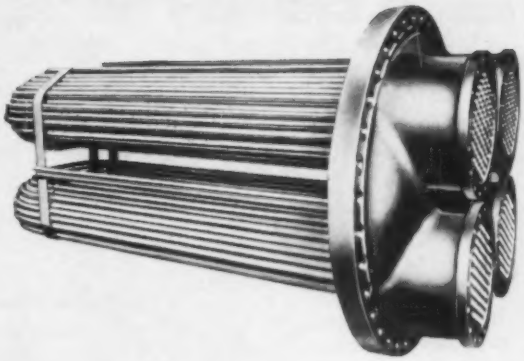
. . . designed to temper outside air and supply it in sufficient quantities to eliminate negative pressures — *Aerovent Fan Co., Inc., Dept. HPAC, Piqua 29, Ohio.*

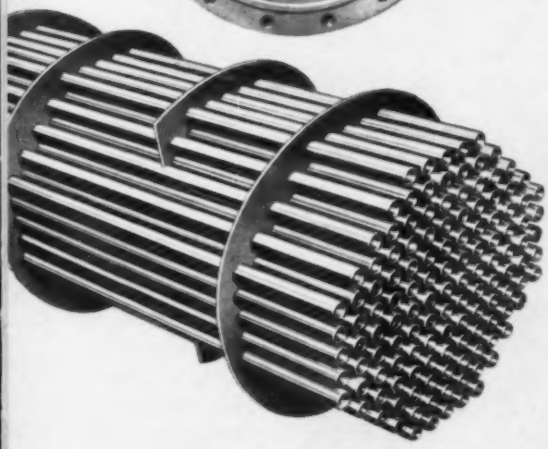
Unit replaces exhausted air with clean, outdoor, preheated air, manufacturer says. Available in seven unit arrangements, in six sizes 24 to 54 in. with air capacities 4000 to 33,000 cfm. Equipment consists of fan and coil assembly with fan mounted in plenum on discharge side of coil. With standard accessories, unit may be used as unit heater or source of filtered air for ventilation.

Steam Coil . . .

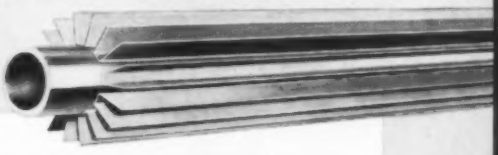
. . . designed to maintain uniform surface temperatures over entire face





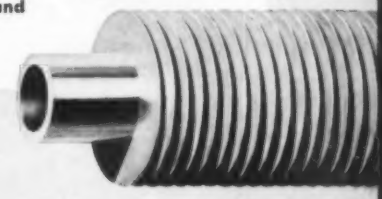


TWO GOOD WAYS TO ADD ADDITIONAL HEAT TRANSFER SURFACE AREA TO B&W CARBON STEEL ERW TUBES



(A) Longitudinal Channels Welded On

(B) Continuous Helical Fin Wound Around Tube and Welded On



TUBING REQUIREMENTS FOR HEAT TRANSFER EQUIPMENT

The economy and usefulness of pressure tubing in heat exchanger and condenser applications depend on the tubing's heat transfer ability and the ease with which it can be bent, coiled, swaged, and rolled into tube sheets.

Because of its uniform wall thickness, the heat transfer ability of B&W Electric-Resistance-Welded Carbon Steel Tubing is the optimum for such a ferrous material. It is an economical material to use, not only because of its reasonable first cost, but also because of its low fabrication cost, since ease of bending, coiling, swaging, and rolling into tube sheets is provided through quality-controlled methods used in its manufacture.

B&W Electric-Resistance-Welded Carbon Steel Heat Exchanger and Condenser Tubing is widely used in the process industries, including petroleum refining and chemical processing, and in refrigeration and steam generating equipment. If carbon steel tubing can do the job required, you will find B&W ERW Tubing provides maximum, trouble-free service life. For additional information, call on Mr. Tubes, your nearby B&W Tube Representative — *or write for Bulletin 412.* The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

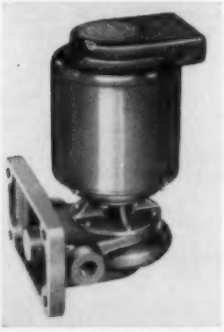
TA 6099 PG-2

Seamless and welded tubular products, seamless welding fittings and forged steel flanges—in carbon, alloy, and stainless steels

EQUIPMENT DEVELOPMENTS
Continued

area of fluctuating load demands — *Marlo Coil Co., Dept. HPAC,* 7100 *S. Grand Blvd., St. Louis* 11.

"Evntemp" provides uniform leaving air temperatures free of all stratification with consistency necessary for precise control in modern heating systems, company says. Tubes pitched in casing for rapid condensate drainage, ease of installation. Each coil has steam supply connection and condensate connection on same end.



Flange Mounted Pump . . .

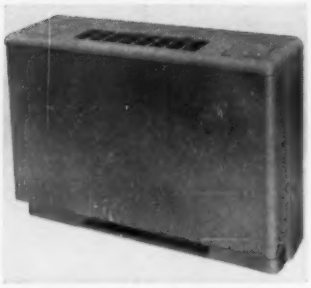
. . . with triple discharge — *Ruthman Machinery Co., Dept. HPAC,* 1809 *Reading Rd., Cincinnati* 2.

Model "5S-4520" has three discharges: one on right side; one on left side of housing; one optionally tapped through inlet port of mounting flange. Discharges may be used individually, in pairs, or simultaneously. Pumps available with either 1/10 or ¼ hp motors. Height of ¼ hp size is 13 3/16 in.; of 1/10 hp size, 11 7/16 in. Various diameter impellers available for capacities to 30 gpm, heads to 27 ft.

Sealing Compound . . .

. . . for pipe joints — *W-K-M Mfg. Co., Div. of ACF Industries, Inc., Dept. HPAC, Box* 2117, *Houston.*

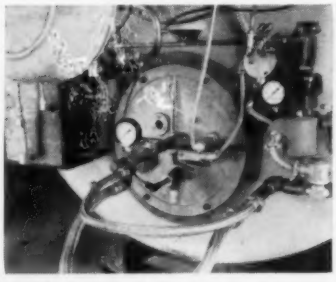
New "Key-Tite" designed to provide maximum seal in screw thread, gasket joints. Offers uniform coverage of surface, eliminating seizing of joints, company says. Used in gas, water, low pressure steam, compressed air, similar applications.



Room Air Conditioner . . .

. . . featuring variety of styles in sizes 220 to 600 cfm — *Dunham-Bush, Inc., Dept. HPAC,* 179 *South St., West Hartford* 10, *Conn.*

New "CR" available in cabinet, recessed, vertical, horizontal models with combination cooling and heating coils, combination direct expansion and steam coils, three control kits. Vertical units with cabinet may be exposed or semi-recessed. Basic units may be completely recessed. Horizontal units with cabinet can by suspended from ceiling in conditional space, company says.



Boilers . . .

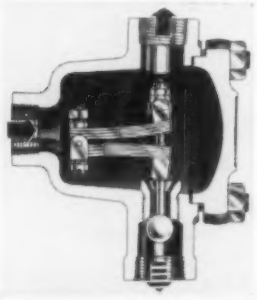
. . . with single tip retractable nozzle — *Cleaver-Brooks Co., Dept. HPAC,* 326 *E. Keefe Ave., Milwaukee* 12.

Nozzle offers more stable combustion, more positive mixing action of oil and air, manufacturer says. Other features of boilers cited by company: four pass construction; forced draft; updraft construction; 5 sq ft of heating surface per boiler hp; vibrationless impeller.

Hot Pipe Insulation . . .

. . . with waterproofing admixes in combination with graded aggregates, portland cement — *Zonolite Co., Dept. HPAC,* 135 *S. La Salle St., Chicago* 3.

New "b-t-u" system has high mechanical strength, load bearing, thermal characteristics and is extremely resistant to water penetration, company says. Designed for locations with good ground water conditions, firm soil. Firm's network of applicators offers "cast in place," monolithic system of hot pipe insulation to fit variety of job conditions.



Freeze Protector . . .

. . . designed to protect condensate lines in cold weather — *Velan Steam Specialties, Inc., Dept. HPAC,* 37 *S. River St., Plattsburg, N. Y.*

Unit consists of bimetal element in forged steel body with all stainless steel trim, stellited valve seat. Installed in low points of return mains or before risers; normal temperature of condensate keeps valve closed. In event of boiler pressure failure or line blockage, resulting temperature drop will cause element to open valve to atmosphere at predetermined temperature of 90 to 120 F, company says. Available in ½, ¾, 1 in. connections, with larger sizes available on request.

Baseboard Heaters . . .

. . . with increased watt power — *General Alliance Corp., Dept. HPAC,* 2105 *Moore St., San Diego* 1, *Calif.*

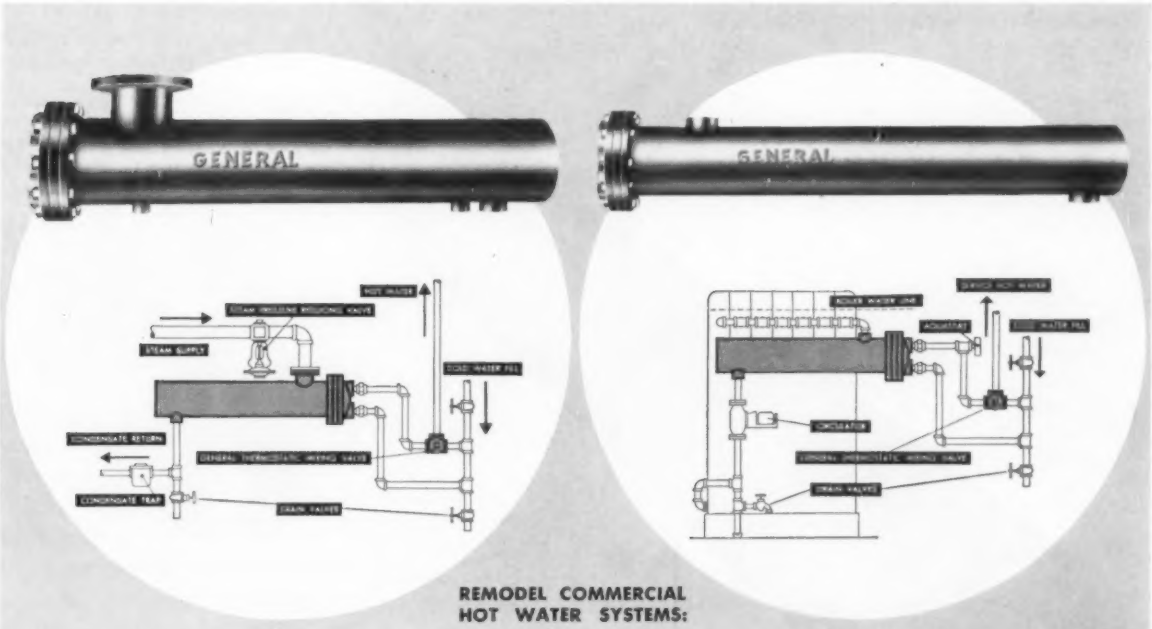
Radiant convector units, 500, 1000, 1500, 2000 watts, available in modular lengths of 2, 4, 6, 8 ft. Each heater complete in itself; may be individually joined to make continuous lengths of baseboard channeling, company says. Features cited by manufacturer: two-piece construction; built-in wiring raceway; prewired heater; junction box on either end; modern design.

You Get These 3 Big Job-Advantages with GENERAL INSTANTANEOUS WATER HEATERS

1 A Compact, Efficient Service Hot Water System — at ⅓ the cost! With simple, compact GENERAL Instantaneous Water Heaters, you can now replace bulky, out-dated storage tank systems in commercial and industrial buildings, apartments, motels, institutions . . . give your customers a modern source for continuous hot water at a fraction of former cost! General Instantaneous Heating requires no space-consuming tank. Water is heated only as needed. Fuel consumption and heat waste are minimized. In both economy and efficiency, it gives you a real competitive advantage in today's big remodeling field!

2 Easy Installation Installation of General Instantaneous Heaters is also quick, easy — more profitable to you. Piping is short and simple. Capacities to 300 gpm. Largest of 20 heater sizes is less than 21″ by 84″. Heating unit is located directly at boiler for boiler water systems . . . or tapped in existing steam lines with live or exhaust steam as heat source.

3 Little Maintenance — No Costly Call-Backs On-the-job performance has shown that General Instantaneous Heaters outlast, by far, all other types of water heating systems. Rugged, engineered design meets precise job specifications. Less piping means less maintenance. Seamless copper tubing, and all-bronze head and tube plate assure clean, rust-free hot water . . . years of trouble-free operation.



REMODEL COMMERCIAL HOT WATER SYSTEMS:

STEAM With steam as heat source, General Instantaneous Heaters can be spotted anywhere near existing steam lines — on the floor, wall, overhead and out of the way.

BOILER WATER Simple installation with General Instantaneous Heater mounted at boiler. Saves fuel and heat . . . provides plenty of continuous, hot water, even when boiler is operated at 180° during summer months. Baffle-type construction provides extremely efficient heat transfer . . . high output from small unit.

MAIL COUPON TODAY!

GENERAL FITTINGS COMPANY

Instantaneous Water Heaters, Converters, Fuel Oil Heaters, and Heating Specialties

GENERAL FITTINGS COMPANY
P. O. Box 151E, East Greenwich, R. I.

Gentlemen: Please send descriptive catalog for the complete line of GENERAL Instantaneous Water Heaters.

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Company.....

Address.....

City..... **State**.....

ANNOUNCING...

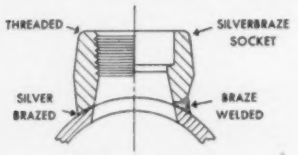
BONNEY

WELDOLETS
THREDOLETS
SOCKOLETS
and
BRAZOLETS

for branch connections on brass copper and cu-ni piping

BRONZE FITTINGS

Brazolets for silver brazing or Thredolets or Sockolets for oxyacetylene braze welding to copper or brass pipe



size range
outlet sizes ¼"—2"
run pipe sizes 1"—24"

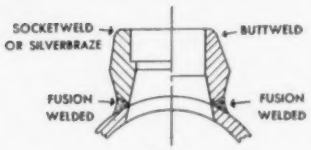
available in any combination of outlet and header connection type

APPLICATIONS

PLUMBING AND HEATING
PROCESS PIPING
SHIP PIPING

COPPER NICKEL FITTINGS

Weldolets and Sockolets
for fusion welding to copper nickel pipe



size range
outlet ¼"—6"
run pipe sizes 1"—24"

APPLICATIONS

U.S. NAVY BUREAU OF SHIPS AND U.S. COAST GUARD PIPING

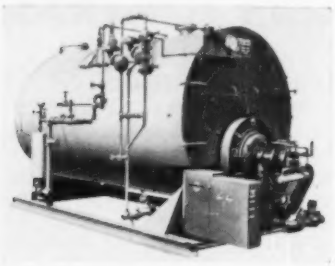
BONNEY

WELDOLETS ®
THREDOLETS ®
SOCKOLETS ®
BRAZOLETS ®

PENNSYLVANIA DIVISION
BONNEY FORGE & TOOL WORKS
Dept. C
ALLENTOWN, PENNSYLVANIA

EQUIPMENT DEVELOPMENTS

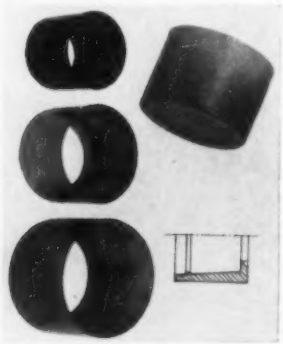
Continued



Packaged Boilers . . .

. . . for firing all grades of fuel oil, gas, combination oil-gas — *Western Boiler Co., Dept. HPAC,* 1600 *N. Indiana St., Los Angeles* 63.

"Webco" forced and induced draft units have ratings 25 to 600 hp; pressure forced draft models range 10 to 100 hp. All boilers factory assembled, wired, pretested, company says. Each encased with metal jacketed glass fiber sheath.



Pipe Thread Protector . . .

. . . molded of polyethylene in colors to indicate size — *Protector Products, Inc., Dept. HPAC,* 2144 *W.* 15*th St., Cleveland* 13.

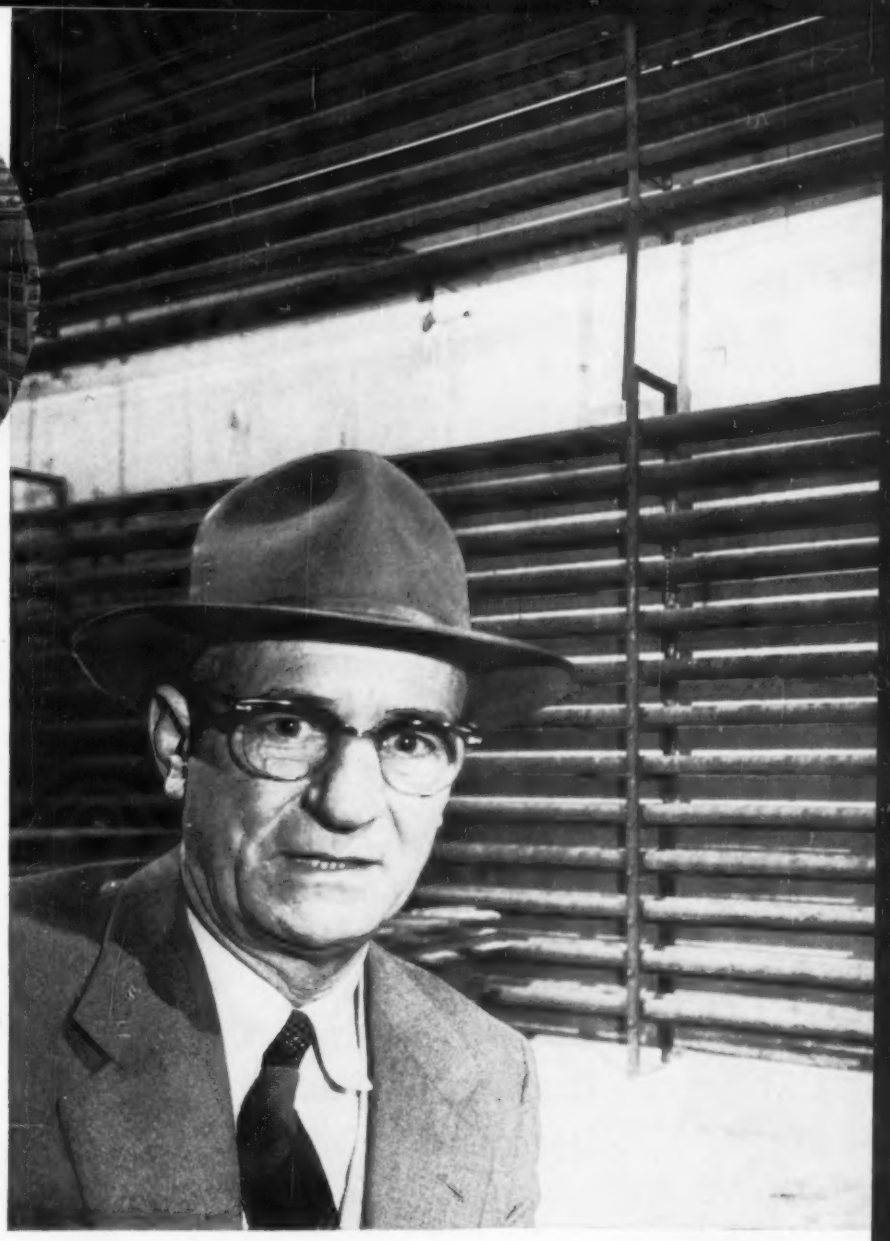
Interior surfaces tapered at same angle as thread so that there is contact for full thread length which increases gripping surface, thereby preventing caps from being removed accidentally, company says. Available in either open end or closed end styles. Heaviest end of taper located at top to provide first thread with maximum protection.

"Spiral Wound" Ducts . . .

. . . for air conditioning — *Carrier Corp., Dept. HPAC,* 300 *S. Geddes St., Syracuse* 1, *N. Y.*

Grapes are stored at 32°F, potatoes at 40°F. Anhydrous ammonia, carried in SPANG CW Steel Pipe, is used as the refrigerant.

Mr. George Eckert, standing in one of the storage cooler rooms, reports on performance of SPANG CW Steel Pipe at Bakersfield Ice & Cold Storage Company. Despite acid action and earthquake vibrations, no replacements have been necessary in almost 15 years service.



"ACID ACTION HAS FAILED TO MAR THE PERFORMANCE OF SPANG CW STEEL PIPE IN OVER 14 YEARS SERVICE"

says Mr. George C. Eckert, Vice President and Manager, Bakersfield Ice & Cold Storage Company, Bakersfield, Calif.

"Repeated coatings with sulphuric acid film, occasional earthquake vibrations, and a constant flow of anhydrous ammonia have all failed to damage our SPANG CW Steel Pipe, installed in 1942. In fact, no piping replacements have been necessary during the almost 15 years of continuous operation to which the pipe has been subjected," reports Mr. Eckert.

"Last year we stored 85 carloads of grapes. The control of bacteria and insect life on grapes requires the weekly use of sulphur dioxide gas which is sprayed into the storage room. The gas changes into sulphuric acid when it strikes moisture, forming a highly corrosive film on the pipe surface. This acid action, however, has failed to mar the performance of the SPANG CW Steel Pipe which has endured this condition for more than 14 years, and is still giving good service," commented Mr. Eckert.

THAT'S SPANG QUALITY CONTROL AT WORK!

Quality Control in manufacturing builds long years of service into every foot of SPANG CW Steel Pipe. Careful attention to temperatures and forming and welding pressures produces in SPANG that extra *quality* that means extra service for you.

Prove to yourself what SPANG Steel Pipe can do for you. Make your next pipe order SPANG CW Steel Pipe. Your nearby Spang distributor will be glad to serve you.

SPANG CW® STEEL PIPE

SPANG-CHALFANT

Division of The National Supply Company

General Sales Offices: Two Gateway Center, Pittsburgh, Pa. District Sales Offices: Atlanta, Boston, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis

New RIDGID
4PJ Geared Threader
is now
* JAM-PROOF

"...It's Safe, Boss... I Don't Need To Watch It...It Won't Jam"

Patents Applied for

*Automatically Stops Threading After Standard Length Thread Is Cut

Power drive threading is safe and easy with this new 4PJ—no more watching of either die stock or drive! 4PJ can't jam—drive pinion kicks out automatically after full thread is cut. Extra-easy to handle . . . mistake-proof workholder, no bushings . . . fully enclosed gears . . . RIDGID most-for-your-money—Buy new 4PJ at your Supply House!

RIDGID 400A Power Drive with Universal Drive Shaft operates 4PJ Threader on 2½" to 4" pipe held in Tristand Chain Vise, all RIDGID products.

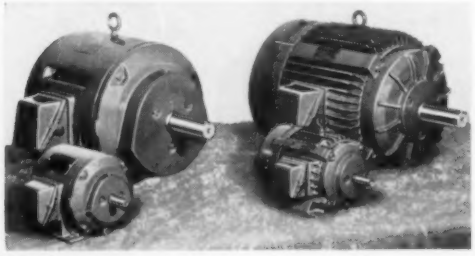
The Ridge Tool Company, Elyria, Ohio, U.S.A.

RIDGID
Work-Saver Pipe Tools

EQUIPMENT DEVELOPMENTS

Continued

Pipe in standard diameters of 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16, 18, 20, 22, 24 in. available. Zinc coated steel, aluminum, or copper is available. New machine for making these ducts has been perfected, according to manufacturer.



A-C Motors . . .

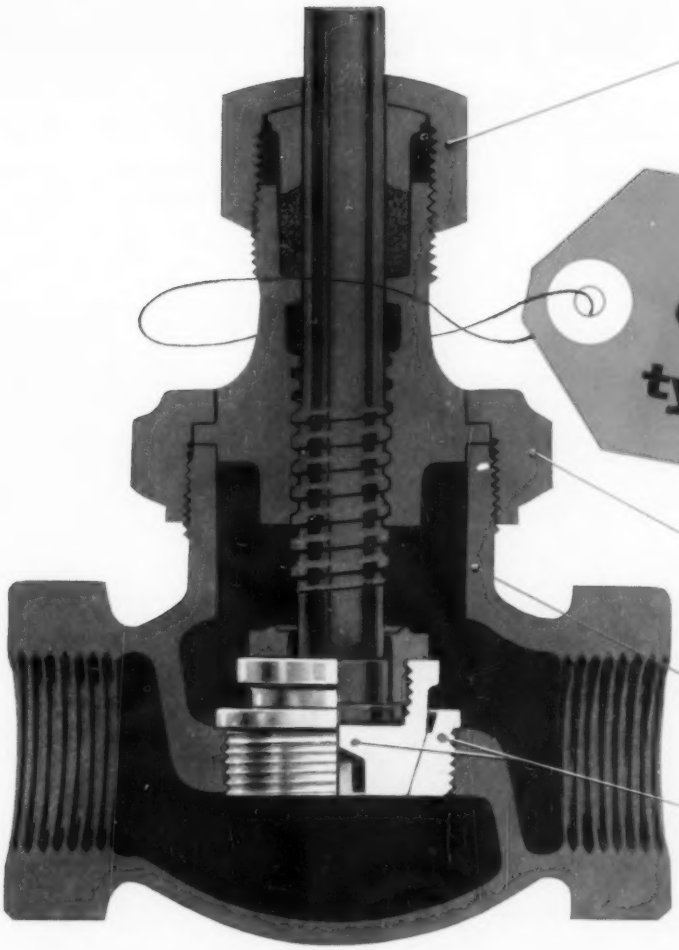
. . . in new, large NEMA frame sizes 364U through 445U — *Reliance Electric and Engineering Co., Dept. HPAC, 24701 Euclid Ave., Cleveland 17.*

Foot mounted, footless horizontal models in 360 frame diameter size available for operation on 208 through 550 volt a-c. Other frame sizes through 125 hp with modifications being manufactured on monthly schedule. Part winding starting — engineered to eliminate loading of power supply lines and resultant momentary light dimming—designed for commercial air conditioning, other applications with similar requirements, company says. Among features of motors cited: protected, corrosionproof enclosures; "Metermatic" lubrication; neoprene gasket to protect motor leads.

Photo Comparator . . .

. . . designed to detect minute particles of contaminant in high pressure gases — *Greer Hydraulics, Inc., Dept. HPAC, New York International Airport, Jamaica 30, N. Y.*

Device may be used to check operation, efficiency of filters, dryers, separators, other similar instruments when used with transparent fluids. Said by manufacturer to be sensitive to ½ micron particles when present in quantities of 100 parts to million or more. Unit can be used in any inert gas circuit to 10,000 psi at any normal ambient temperature, company says.



sturdy nut and packing gland can be pulled down to compress packing around stem and prevent leaks. Packing can be renewed with valve under full pressure.

NEW
O-B plug type valve

union ring reinforces body at centerpiece joint and permits dismantling and re-assembling with the least amount of trouble.

even distribution of metal gives added strength all the way around valve body, preventing distortion.

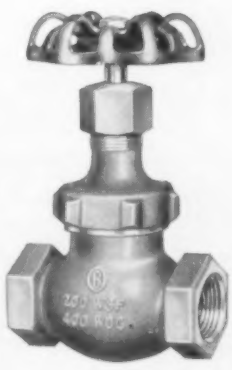
PLUS

Stainless steel seat and disc 500-plus Brinell hardened. Renewable.

for customers who demand a tough, long-lasting valve...

When the service is severe and an ordinary valve just can't take it . . . when the job calls for a valve that will give top performance for a long, long time . . . make your customer happy by putting in a new O-B Plug Type valve. He'll appreciate the ruggedness and the extra long-life features shown above. But, most of all he'll appreciate you for installing a valve that cuts his maintenance problems.

O-B Plug Type valves are available as either globes or angles for 150 lbs. WSP and 200 lbs. WSP. For more complete information contact your O-B distributor, or write to the Ohio Brass Company, 380 North Main Street, Mansfield, Ohio.



O-B VALVES

4729-V

Have you tried J&L's superior quality

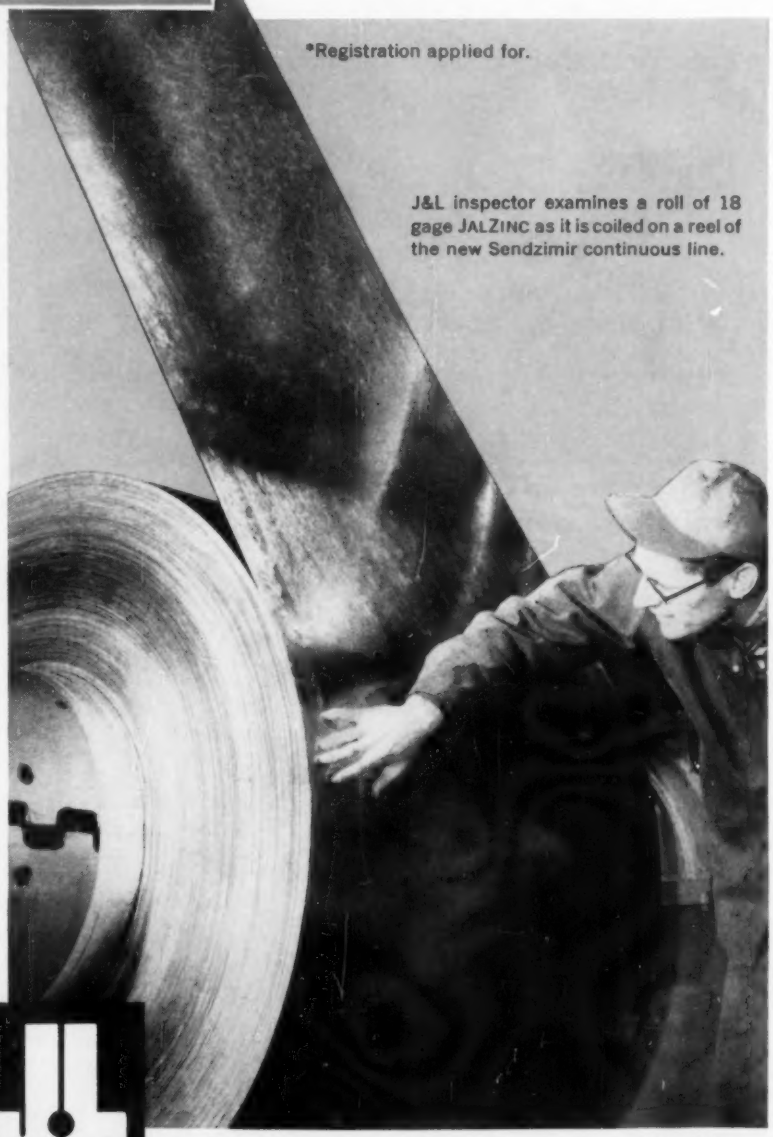
JALZINC*

*Registration applied for.

JALZINC is Jones & Laughlin's new trade name for its *high quality* zinc coated steel sheet and coiled product. JALZINC answers your toughest forming, rolling and drawing problems.

Produced by the proven Sendzimir process, JALZINC has a tight, uniform coating that resists cracking and flaking. The high lustre finish greatly improves the appearance of your end product. JALZINC is available in a wide range of gages and widths in both cut lengths and coils.

Users are enthusiastic about JALZINC'S uniform ductility, flatness and surface finish. Write today for complete details.



J&L inspector examines a roll of 18 gage JALZINC as it is coiled on a reel of the new Sendzimir continuous line.

Jones & Laughlin Steel Corporation
3 Gateway Center, Pittsburgh 30, Pa.

☐ Please send literature on JALZINC
☐ Please have J&L representative call

Name_____

Position_____

Company_____

Address_____

City_____ Zone_____

State_____

J&L STEEL

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COMPACT . . . LIGHTWEIGHT
. . . STREAMLINED AND
ACOUSTICALLY EFFICIENT
NO JOB WAITS FOR

UNI-SILENCER
REG. U.S. PAT. OFF.

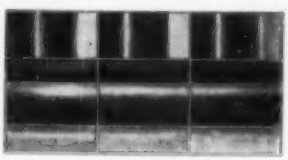
Single Unit
Standard Uni-Silencer

THE NEW SILENCER FOR
AIR CONDITIONING AND
VENTILATING SYSTEMS

UNI-SILENCERS* and UNI-RESONATORS* have been designed specifically to reduce the airborne noise generated by fans in industrial ventilating and air conditioning systems. Low in cost from both the original purchase and installation view, Uni-Silencers are delivered in cartons weighing about 75 lbs each. They may be easily and inexpensively transported into the building to the specific location required.

UNI-SILENCERS* compare favorably in cost with conventional duct lining. When air flow, pressure drop, or noise attenuation require the use of more than one Uni-Silencer, then units (singles, halfs or quarters) may be set together using built-in slip joints. Thus in series, or in parallel Uni-Silencers will fit any condition or requirement.

Uni-Silencer singles and half units set together in block



UNI-SILENCERS* are supplied in 3 sizes: Full Unit-24x24x32": Half Unit-12x24x32": Quarter Unit-12x12x32".

UNI-SILENCERS* are sold on a guaranteed basis. Interior and exterior surfaces are smooth, made of perforated and unperforated metal to reduce resistance to a minimum.

Complete engineering services are yours, FREE!

SEND FOR COMPLETE FREE LITERATURE
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711 Third Avenue, New York 17, N.Y.
Dept. U1-D
Please send complete literature on Uni-Silencers and Uni-Resonators, without charge or obligation.

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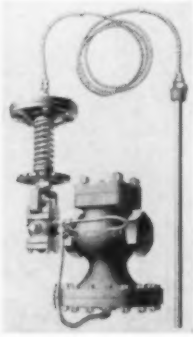
EQUIPMENT DEVELOPMENTS

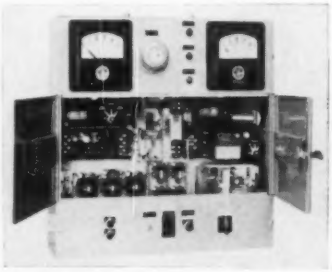
Continued



Temperature Regulator . . .

. . .with main valve controlled by new pilot —*Spence Engineering Co., Inc., Dept. HPAC, Walden, N. Y.*

"T14" pilot designed for slow heating units. When volume of heated fluid is large compared to rate of steam supply, unit produces close regulation; automatically opens, closes main valve as required to maintain constant temperature, company says. Type "ET14" regulator applies line pressure to heating equipment.



Control Cabinets . . .

. . .designed for use singly or in "building block" combinations for versatile mountings such as wall, pedestal, base, floor — *Cleveland Fuel Equipment Co., Dept. HPAC, 1111 Brookpark Rd., Cleveland 9.*

Units in three standard sizes: 24 × 24 × 7 in.; 32 × 24 × 7 in.; 34 × 34 × 8 in. Cabinets finished in baked enamel; piano hinged doors secured by key lock handle. Engineered to group all primary burner controls, burner safety devices, gages, fuses, circuit breakers, signals in one integrated package, manufacturer says.

Now! bigger profits for you with the new Skuttle electric humidifiers!

MODEL 400-T

The Model 400-T Electric Humid-i-Matic for trunk line installation . . . automatically controlled by a Humidistat. (Model 400 available for plenum installation.)

MODEL 800-T

The Model 800-T Electric Humi-Dial for trunk line installation . . . automatically controlled with manual setting. (Model 800 available for plenum installation.)

Why SKUTTLE'S 10 Models* of Electric Humidifiers Will Solve Your Customers Humidity Problems And Make More Profits For You

because only SKUTTLE has a complete line of electric humidifiers for all types of warm air heating and year 'round air conditioning.

because controlled heat is provided to evaporate a given amount of water per hour to provide more positive humidification . . . automatically controlled by a Humidistat.

because SKUTTLE electric humidifiers assure maximum moisture output over conventional type humidifiers.

and . . . finger tip control on both the Model 400-T and Model 800-T give the "just right" humidity in the home.

**All units are also available in 230 volt models.*

Write today for complete information on Skuttle's quality products that give you more profitable sales.

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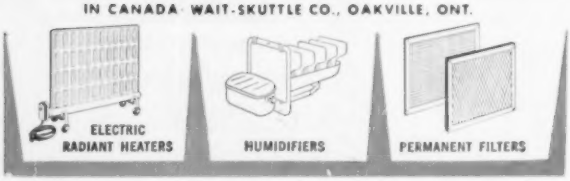
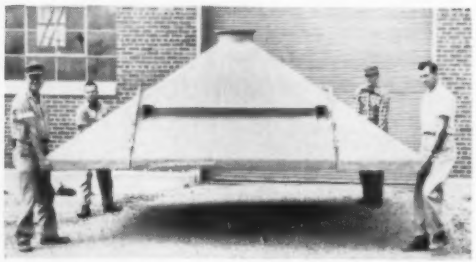


EQUIPMENT DEVELOPMENTS *Continued*



Plastic Hoods . . .

. . . made from fire retardant polyester resin, "Hetron 92," designed to resist corrosion — *Hooker Electrochemical Co., Dept. HPAC, Box 344, Niagara Falls, N. Y.*

Units fabricated in three sections with outside flanges requiring only 42 uncoated nuts, bolts for assembly. High impact strength, sturdiness, lightness among features cited by manufacturer. Smooth, uncluttered exterior surface permits easy washing; pastel colors available, company says.

Table Clamps . . .

. . . designed to hold fully loaded binder in place — *Plan Hold Corp., Dept. HPAC, Box 1055A, South Gate, Calif.*

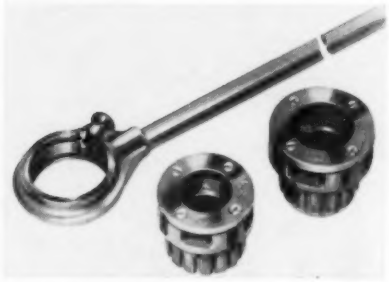
No tools or fasteners required to place or remove binder from secure position within table clamps. Simple twist of wrist and binder is in or out; easy for person to leaf through sheets without having to worry about them slipping out of place, company says.

Refrigeration Oil . . .

. . . for use with all modern refrigerants — *Sun Oil Co., Dept. HPAC, 1608 Walnut St., Philadelphia 3.*

Lower flow point, greater stability, increased copper plating resistance of new "Suniso 3G" permits more efficient operation of compact modern refrigeration units, company says. Product distributed to refrigeration servicemen, wholesalers, industrial users.

EQUIPMENT DEVELOPMENTS — *Continued*



Threading Tool . . .

. . . with pipe threading range 1½ to 2 in. — *Nye Tool Co. Dept. HPAC, 4126 W. Fullerton Ave., Chicago.*

"Triad No. 12" offered by company as supplement to "Triad No. 60" with threading range ⅛ to 1¼ in. Unit equipped with replaceable segmental dies. Each die head designed to carry four segments, accurately machined of steel to insure precision thread cutting performance, manufacturer says.

Mastic Adhesive . . .

. . . for bonding rigid, semirigid foamed plastics to themselves — *Rubber & Asbestos Corp., Dept. HPAC, 225 Belleville Ave., Bloomfield, N. J.*

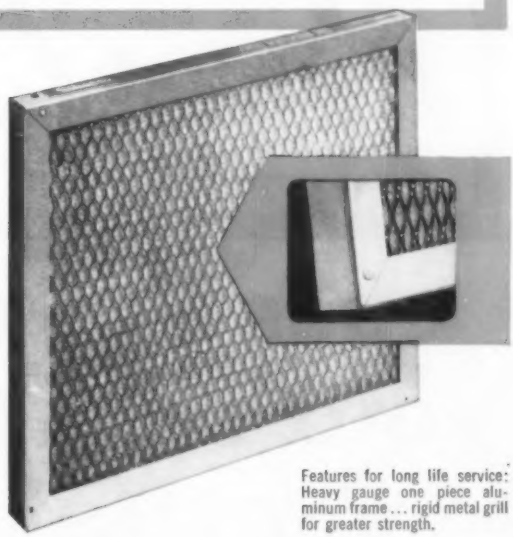
"Bondmaster G458" incorporates solvent blend formulated to minimize or eliminate cell collapse due to attack on surface of foamed styrene, company says. Adhesive designed to resist humidity, freezing temperatures. May be applied with saw tooth spreader, notched trowel, spatula.

Control Unit . . .

. . . designed to provide programmed control of all machine welding functions — *Air Reduction Sales Co., Div. of Air Reduction Co., Inc., Dept. HPAC, 150 E. 42nd St., New York 17.*

New unit consists of main panel which contains adjustable control mechanisms, pushbutton remote control station. System designed for use with high frequency current, d-c straight polarity welding power from saturable reactor controlled, rectifier type supply. Each operation of weld start switch initiates entire weld program which automatically progresses until weld is completed and crater is filled, company says.

You make more profit per filter sale with Skuttle-aire permanent filters!



Features for long life service: Heavy gauge one piece aluminum frame . . . rigid metal grill for greater strength.

Here are the reasons why you get more with Skuttle-Aire:

because they're permanent . . . built for lifetime wear.

because they're cleaned in a jiffy when dust and dirt particles gather, simply remove, clean with plain water and replace . . . that's all there is to it.

because they're maintenance-free . . . nothing to wear or replace, never need oiling.

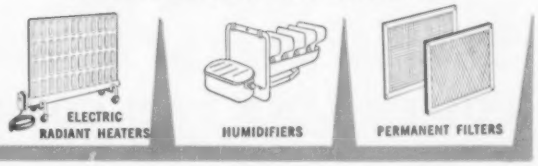
because they're filled with new-type filtering material . . . multiple layers of specially woven plastic filaments with permanent electrostatic qualities, making it the ideal dust and dirt collecting agent.

SKUTTLE-AIRE permanent filters are available in all sizes for furnaces, central air conditioning systems and room coolers.

Write today for complete information on Skuttle's quality products that give you more profitable sales.

Skuttle MANUFACTURING CO.
MILFORD, MICHIGAN

IN CANADA: WAIT-SKUTTLE CO., OAKVILLE, ONT.



Five important reasons why

Power Line

best solves your industrial ventilation problems:

1. Complete line: Broadest product line of air-moving equipment for every industrial requirement.

2. Certified performance: All Power Line Fans are rated by PFMA and by NAFM.

3. Backed by 33 years of specialization in manufacture of highest quality ventilation equipment.

4. Competitively priced to give you important cost savings in initial investment and in maintenance. You get the precisely right product to fit your requirements. You don't over-buy with equipment too large or under-buy with equipment too small.

5. Sold only through qualified ventilation specialists. You get expert technical advice and service from the survey of your requirements right through to the completion of your installation.

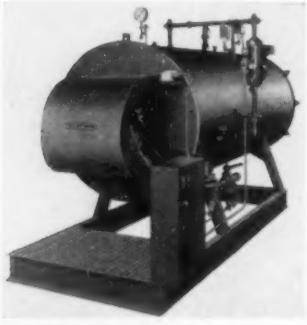
YOURS ON REQUEST: Big 20-page Power Line Catalog gives complete facts about industrial ventilation, including selection of proper type and size of fan, calculation of duct resistance, and installation procedures, plus features, dimensions, specifications and performance data. Without obligation write for your free copy of Catalog No. 97

POWER LINE FAN COMPANY, INC.

Subsidiary of **Chelsea Products, Incorporated** 639 South Avenue, Plainfield, New Jersey

EQUIPMENT DEVELOPMENTS

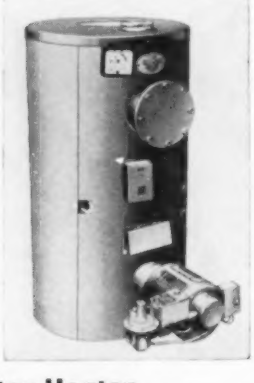
Continued



Gas Fired Boiler . . .

. . . with burner head designed for firing with natural or mixed gases — *York-Shipley, Inc., Dept. HPAC,* 500 *Jessop St., York, Pa.*

Blower at front of "Steam-Pak" automatic unit supplies air for combustion; also forces hot gases through boiler passes. Simplified controls centralized in enclosed panel. Available in 12 sizes from 30 to 125 hp to supply high or low pressure steam and hot water.

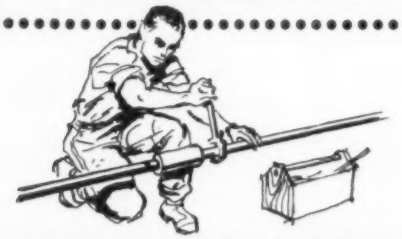


Water Heater . . .

. . . engineered to deliver large volume of rustfree automatic hot water in commercial, industrial installations — *Portmar Boiler Co., Inc., Dept. HPAC,* 193 *Seventh St., Brooklyn* 15.

Unit constructed of heavy gage steel, completely galvanized inside and out. Model "DG-125" has gas input of 140,000 Btu per hour and output of 125 gph at 100 F rise. Test pressure is 150 lb, water working pressure is 125 lb. Company cites multiple flue, 19 sq ft of heating surface as reason for high recovery.

INSTALL IT . . .



FORGET IT!

Flexon® *PACKLESS*
EXPANSION COMPENSATOR

Install it . . . and walk away from it once and for all! Flexon Model H Expansion Compensator is the modern way to take up expansion and motion in pipes up to 3″, because it's *packless.* No maintenance required—ever. It's there to stay, for the life of the building.

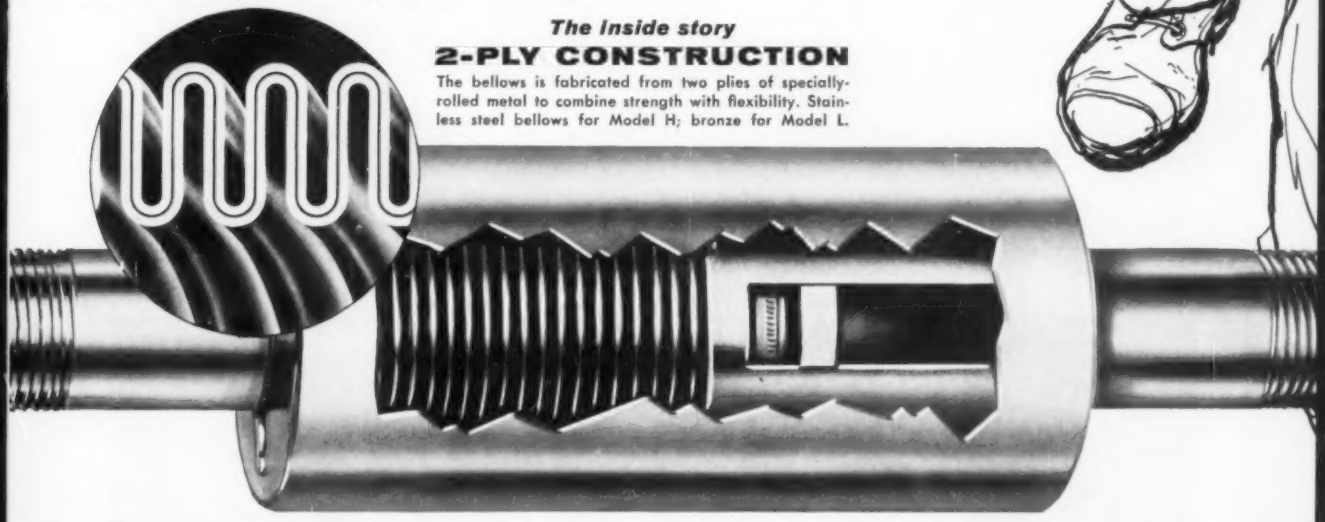
You get delivery when you need it, because Flexon Model H Expansion Compensators are available from stock. *And here's a bonus!* They cost much less per inch of stroke than any other method of absorbing pipe expansion. Up to 1¼″ total movement in all sizes. Working pressures up to 150 p.s.i. for ¾″ and 1″ sizes; up to 100 p.s.i. for larger sizes.

Write for facts about Flexon Expansion Compensators, design and cost data, and the name of your Flexon distributor.

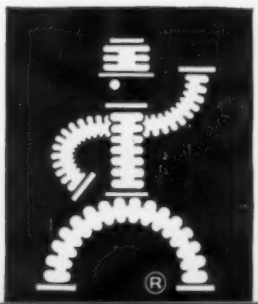
The Inside story

2-PLY CONSTRUCTION

The bellows is fabricated from two plies of specially-rolled metal to combine strength with flexibility. Stainless steel bellows for Model H; bronze for Model L.



EC-110



Flexonics
corporation

EXPANSION JOINT DIVISION • 1391 S. THIRD AVENUE, MAYWOOD, ILLINOIS

EXPANSION JOINTS

METAL HOSE

NON-METALLIC HOSE

BELLOWS

AIRCRAFT COMPONENTS

Specify RECO

Boiler Plant, West Wing and Mercy Hall—St. Mary's Hospital, Knoxville, Tenn.
Consulting Engineers—A. F. G. Bedinger, Knoxville, Tenn.—H. F. Wilson, St. Louis, Mo.
Architects—David B. Liberman, Knoxville, Tenn.—Maguolo & Quick, Cincinnati, Ohio.
Contr.—John F. Whelahan Co., Knoxville, Tenn.
RECO Representative—Dickey Engineering Co., Knoxville, Tenn.

Hot Water Treatment by RECO for St. Mary's Hospital

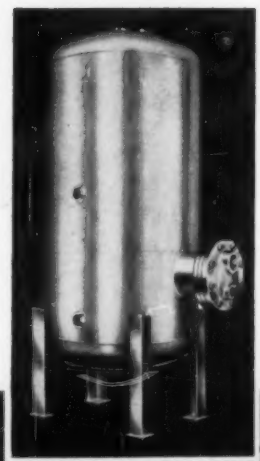
When it comes to hot water, a hospital really pours it on. That's why the consulting engineer "prescribed" RECO water heating equipment for the new buildings at St. Mary's.

The complete RECO installation includes convertors, storage heaters, expansion and bulk storage tanks. 17 units in all... Guaranteed to keep plenty of rust-free hot water always on tap.

If you're interested in guaranteed top quality heat exchange equipment—delivered quickly and priced right—SPECIFY RECO on *your* next heating job.

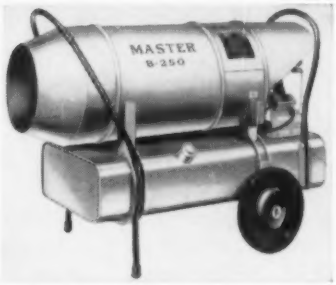
Write for free catalogs plus name of nearest RECO representative.

Dept. N, Richmond Engineering Co., Inc., 7th & Hospital Sts., Richmond 5, Va.



RICHMOND ENGINEERING CO., INC.

EQUIPMENT DEVELOPMENTS
Continued



Portable Heater . . .

. . . designed to deliver 250,000 Btu per hr — *Master Vibrator Co., Dept. HPAC, 1752 Stanley Ave., Dayton 1, Ohio.*

Model "B-250" suitable for contractors in areas where more heat is needed to thaw and dry materials, to "spot heat" outside, to heat enclosures, company says. Operates 16 hr on tank of kerosene or fuel oil; thermostat provided for safe, automatic operation. Portable heaters also available in 100,000, 400,000 Btu sizes.

Tape Duct Connections . . .

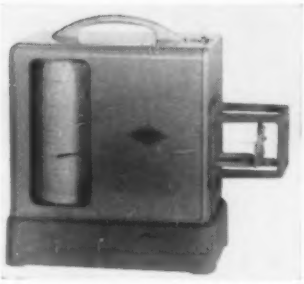
. . . for use with heating, air conditioning systems — *Grant Wilson, Inc., Dept. HPAC, 141 W. Jackson Blvd., Chicago 4.*

Made of heavy woven canvas fabric, tape has ability to reduce noise, vibration in variety of heating, cooling, ventilating equipment, company says. Available in 6, 10 in. widths. Each 100 ft roll packed in carton.

Graphing Instrument . . .

. . . to record minute changes in ambient relative humidity — *Serdex, Inc., Dept. HPAC, 91 Cambridge St., Boston 14.*

"Microhygrograph" utilizes diaphragm made of animal membrane, makes minute fluctuations in relative humidity visible by recording them on 12 × 6 in. chart covering 24 hr period. Suitable for monitoring air conditioning systems used to accurately control humidity in industrial, laboratory operations, company



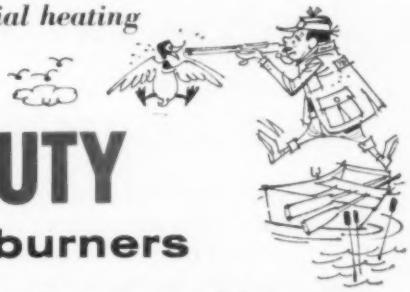
says. Operating range is 15 to 95 percent relative humidity at temperatures 32 to 130 F. At temperatures below freezing, correction chart is used.

Electrode . . .

. . . using free arc or drag technique — *Hobart Bros. Co., Dept. HPAC, Troy, Ohio.*

Unit provides shallow rippled, smooth weld deposit in all positions, manufacturer says. Designed for applications requiring high tensile strength, ductility, x-ray quality such as high pressure mild steel piping.

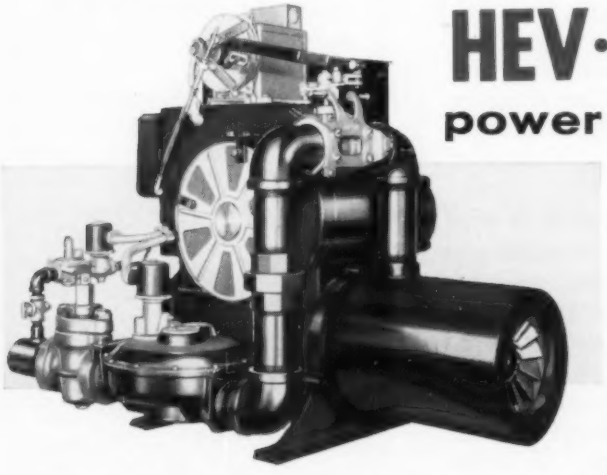
Sure-fire ways to bag 4 "birds" who buy gas commercial heating



Yours with only

HEV·E·DUTY

power gas burners



The Combustion Efficiency Hawk

This bird's easy because HEV-E-Duty power gas burners operate at peak combustion efficiency under *all* conditions — weather, location, type of boiler, type and size of stack. Gas is burned entirely in suspension with perfectly controlled, quiet flame.

The CO Quail

HEV-E-Duty power gas burners automatically maintain correct air-to-fuel mixture which results in combustion with high CO_2 . . . NO CARBON MONOXIDE. Operate equally well when burning oil as a steady standby measure.

The Gadget-Seeking Grouse

Quality-built, superbly engineered HEV-E-Duty power gas burners are equipped with the finest and most modern gas controls and *electronic* flame failure safeguards.

The Thrifty-Minded Road Runner

Whatever this bird has in mind, he'll find it in the competitively priced line of 26 models including straight gas, combination light oil and gas, combination heavy oil and gas.

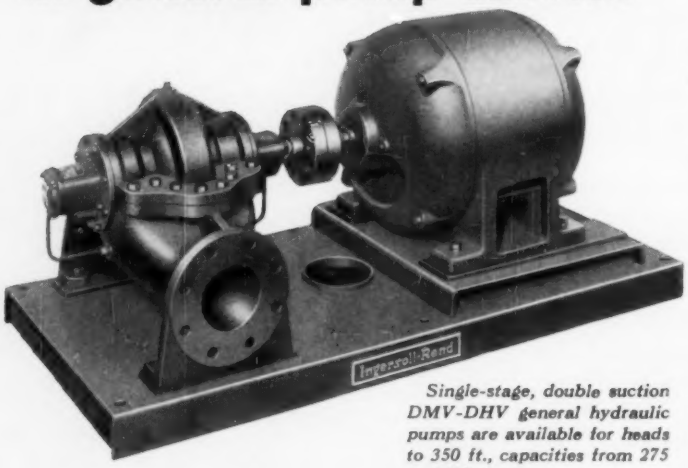
Write today for details on select dealer franchises still available.

Cleaver-Brooks Company
Burner Division

Dept. P, 392 East Keefe Avenue, Milwaukee 12, Wisconsin

ENDS MAINTENANCE

in general pump service



Single-stage, double suction DMV-DHV general hydraulic pumps are available for heads to 350 ft., capacities from 275 to 2400 gpm.

Double shaft seals and sealed ball bearings—standard equipment on **DMV— DHV** *pumps do away with stuffing box attention and bearing lubrication*

Now, with the DMV-DHV pump, you no longer have any stuffing box worries. There's no repacking! No annoying pump shaft leaks! The Double Mechanical Shaft Seals used are completely self-adjusting. They don't require attention throughout their entire service life.

Moreover, greasing or oiling of pump bearings is done away with. Modern Cartridge-Type Ball Bearings are employed—with the lubricant permanently sealed in. Here's another advanced feature that makes the DMV-DHV design the simplest, most maintenance-free pump ever developed by Ingersoll-Rand for general hydraulic service.

Greater Compactness is obtained with this modern construction using mechanical shaft seals and sealed bearings.

See your nearest Ingersoll-Rand representative for further information.

Ingersoll-Rand

10-290 Cameron Pump Division
11 Broadway, New York 4, N. Y.

PUMPS • CONDENSERS • TURBO-BLOWERS • COMPRESSORS • ROCK DRILLS
GAS & DIESEL ENGINES • AIR & ELECTRIC TOOLS

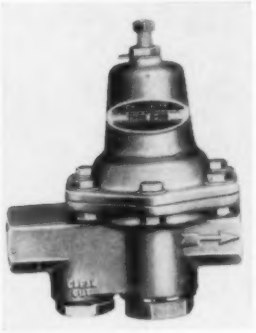
EQUIPMENT DEVELOPMENTS

Continued

Direct Fired Heaters . . .

. . . with four pass counterflow heat transfer — *Lennox Industries, Inc., Dept. HPAC, Des Moines, Iowa.*

Primary heat transfer surface constructed of heat resistant stainless steel permitting unit to be mounted on floor or suspended from ceiling. High velocity jet air stream cools heat transfer surfaces. Blower section equipped with giant blowers operating at relatively low shaft rpm, delivering high cfm capacities with nominal requirements, manufacturer says.



Valve . . .

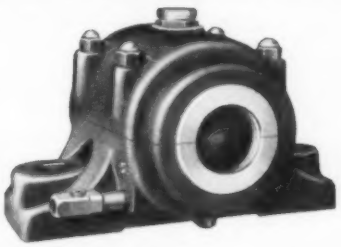
. . . for water pressure reducing service — *A. W. Cash Valve Mfg. Corp., Dept. HPAC, Wabash & Morgan Sts., Decatur, Ill.*

"Type E-93" unit provides dependable accuracy; suitable for either cold or hot water service; available in ½ to 2 in. pipe sizes, company says. Construction details include all bronze housing, brass internal parts, heat resistant seat disc and diaphragm, rustproof steel bolting, stainless steel body seat. Large area monel strainer screen protects working parts, has separate cleanout plug for flushing. Maximum initial pressure is 250 psi.

Temperature Control . . .

. . . designed for use in locations where explosive vapors, gases are present — *United Electric Controls Co., Dept. HPAC, 79 School St., Watertown, Mass.*

Bright Lights–That Never Fail



SLEEVOIL BEARINGS

Dodge Sleevoil Bearings are available in plain type or water-cooled. They are self-aligning. Can be drilled for thermostatic emergency warning if desired. Shaft sizes from 1-7/16" to 10".

The brilliant lights of Broadway match the stars in the certainty of their rising. A black-out from power failure is almost unthinkable.

One factor that contributes to the dependability of this steady power supply is the bearing that insures unfailing operation of mechanized draft in the generating plant.

These Bearings are Dodge Sleevoil.

Generating plants throughout America—including those in such metropolitan centers as New York, Detroit, San Francisco, Los Angeles—use these super-quality bearings.

The Sleevoil Bearing is a Dodge development, created especially to meet the exacting requirements of fan and blower service. You are invited to write us for our new Engineering Catalog D56, which contains detailed description, sizes, dimensions.

DODGE MANUFACTURING CORP., 1600 Union St., Mishawaka, Indiana

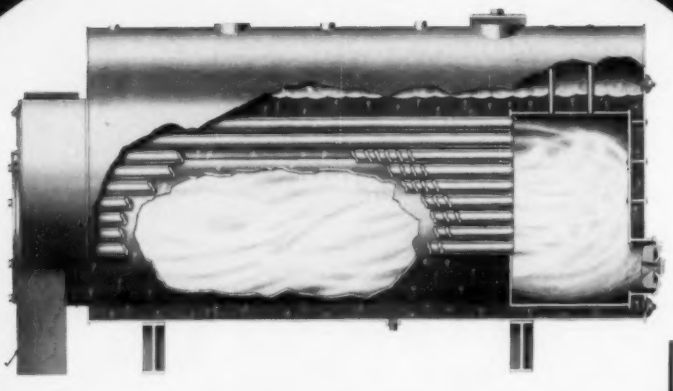
CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on modern power transmission machinery for *modern* installations. Look for his name under "Power Transmission Equipment" in your classified telephone directory.

DODGE
of Mishawaka, Ind.

THE *Fitzgibbons* BOILER®

"SCOTCH" TYPE

For catalog on this Fitzgibbons Steel Boiler write to the Fitzgibbons Boiler Company, Inc., address below.



"Most Economical in Fuel"

Full Wet Back Construction – A design feature promoted by Fitzgibbons for many years. The rear horizontal combustion area is completely water jacketed on top, sides and back, eliminating need of any refractory lining.

Low Headroom – is a feature of the Fitzgibbons "Scotch" Type Boiler. No expensive base setting is required and the lower waterline of the design provides substantial savings in boiler room installations through the elimination of extra excavation.

Easy Cleaning – is always possible with a Fitzgibbons "Scotch" Type Boiler through accessible openings to all combustion surfaces – the firebox, tubes and rear combustion chamber.

High Efficiency – 80% or better when properly installed with a well-designed, correctly adjusted oil or gas burner.

Fitzgibbons
Boiler Company, Inc.
101 PARK AVENUE, NEW YORK 17, N. Y.
Dept. 20

SINCE 1886 MOST ECONOMICAL IN FUEL THE FITZGIBBONS BOILER

FB115

EQUIPMENT DEVELOPMENTS
Continued

"E95" composed of remote bulb thermal device and control head with connecting capillary tube. Head compensation effective from −65 to 160 F. Models available with adjustable range spans of 100 F or 200 F between limits of −150 and 650 F with on, off differentials of approximately 1, 2 F. New unit has cast iron enclosure.

Silencer . . .

. . . designed to prevent transmission of noise through return air vents without impeding passage of air — *Industrial Acoustics Co., Dept. HPAC,* 341 *Jackson Ave., New York.*

"Quiet Vent" features functional construction designed to fit snugly inside normal walls; one-piece construction makes handling, installation easy, company says. Available in variety of sizes to suit individual requirements, applications. Constructed of 22, 24 gage steel.

Transmitter . . .

. . . for measuring pressures to 250 psi or ranges 0 to 100 in. of water — *Conoflow Corp., Dept. HPAC,* 2100 *Arch St., Philadelphia* 3.

A Profitable Part of Today's Construction Picture...

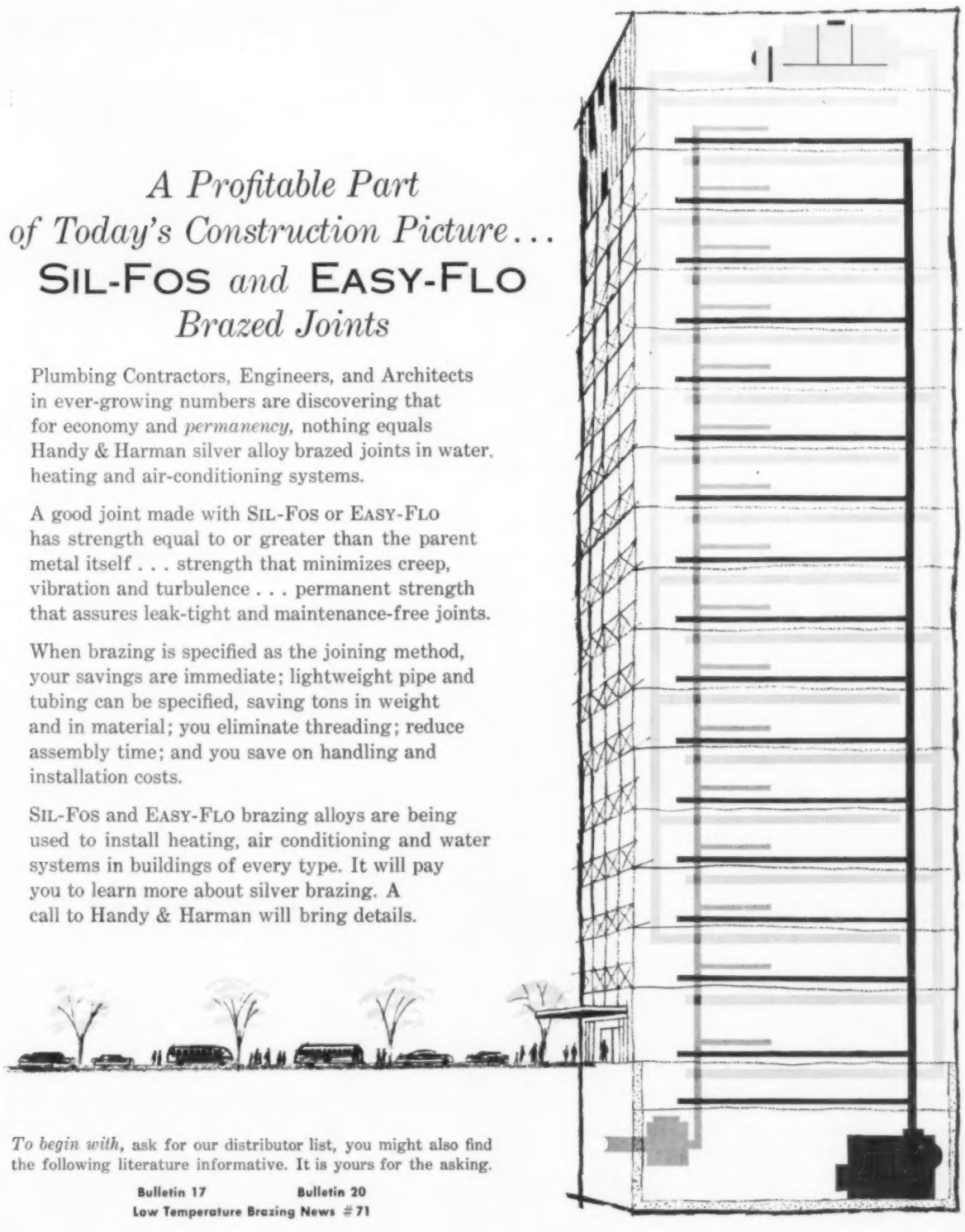
SIL-FOS *and* EASY-FLO *Brazed Joints*

Plumbing Contractors, Engineers, and Architects in ever-growing numbers are discovering that for economy and *permanency*, nothing equals Handy & Harman silver alloy brazed joints in water, heating and air-conditioning systems.

A good joint made with SIL-FOS or EASY-FLO has strength equal to or greater than the parent metal itself . . . strength that minimizes creep, vibration and turbulence . . . permanent strength that assures leak-tight and maintenance-free joints.

When brazing is specified as the joining method, your savings are immediate; lightweight pipe and tubing can be specified, saving tons in weight and in material; you eliminate threading; reduce assembly time; and you save on handling and installation costs.

SIL-FOS and EASY-FLO brazing alloys are being used to install heating, air conditioning and water systems in buildings of every type. It will pay you to learn more about silver brazing. A call to Handy & Harman will bring details.



To begin with, ask for our distributor list, you might also find the following literature informative. It is yours for the asking.

Bulletin 17 **Bulletin 20**
Low Temperature Brazing News #71

Your NO. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN
General Offices: 82 Fulton St., New York 38, N. Y.
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OFFICES and PLANTS
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BRIDGEPORT, CONN.
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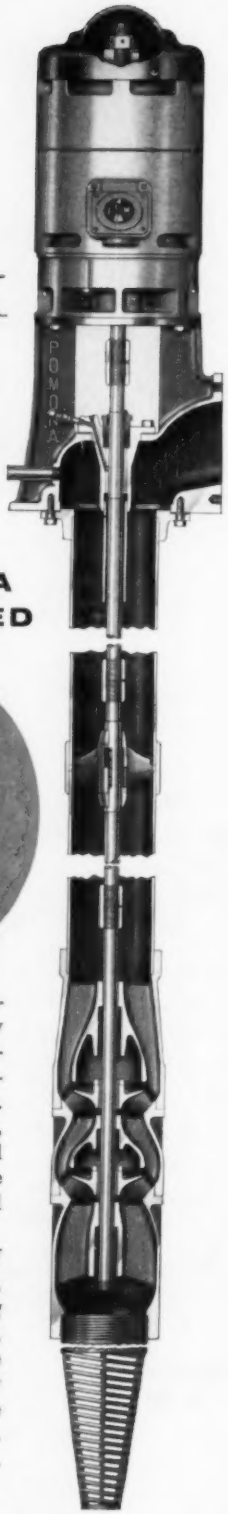
CLEVELAND, OHIO
DETROIT, MICH.
LOS ANGELES, CALIF.
OAKLAND, CALIF.
TORONTO, CANADA
MONTREAL, CANADA

You'll want to look into this pump



NEW F-M POMONA WATER-LUBRICATED TURBINE PUMP

For ruggedness of construction, simplicity of maintenance, and strictly quality design throughout—this all-new Fairbanks-Morse Pomona turbine pump is today's greatest value. No other pump is so easily installed, so easy to adjust for varying field conditions, so simple to change between electric, belted or geared drive.

Ask for details on this new F-M Pomona pump for raw water supply, air conditioning, refrigeration, cooling towers, sump pumping, dewatering, etc. Contact your Fairbanks-Morse Sales Engineer today. Ask for new illustrated Bulletin 6957-1. Or write Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS

EQUIPMENT DEVELOPMENTS

Continued

Operating on force balance principle, model "P" transmits linear 3-15 psi signal to recorder, indicating gage, or manometer. Unit may be mounted either horizontally or vertically on both open, closed tanks. Design eliminates possibility of measured material backing up into air lines in event of pressure diaphragm rupture, company says.

Blower Housing . . .

. . .in new pink color — *Utility Fan Corp., Div. of Utility Appliance Corp., Dept. HPAC,* 911 *E. 59th St., Los Angeles* 1.

Housing of blower fans for factories painted pink to make them more attractive for employees, company says. Blower fan blades continue to be painted red.

Plastic Foam Tape . . .

. . .for insulation, cushioning, noise reduction — *United Mineral & Chemical Corp., Dept. HPAC,* 16 *Hudson St., New York* 13.

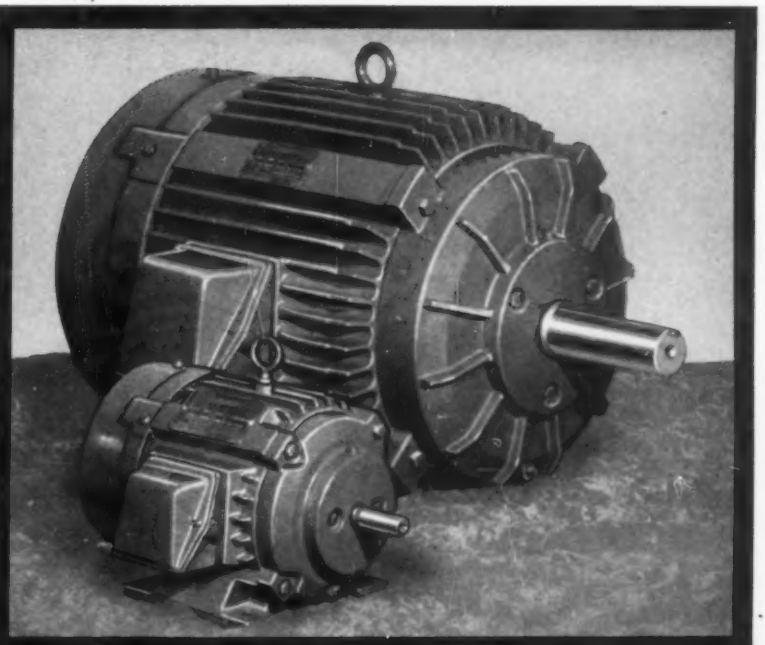
Produced in various thicknesses in roll widths to 18½ in. Cited features: resiliency, elasticity, chemical and physical stability, odorlessness, rotproofness. Can be used as vibration absorbing material for insulating, air and dust sealing on air conditioning, ventilating, refrigerating, heating equipment.

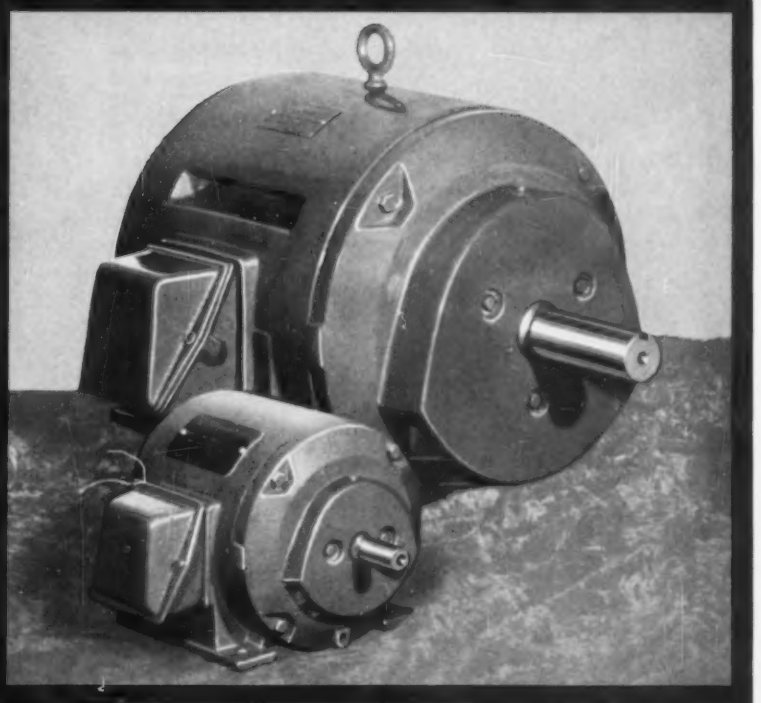
Calculator . . .

. . .for reading heat loads — *Paul S. Morton Engineering Service, Dept. HPAC,* 5131 *Meadowlark Ln., Kalamazoo, Mich.*

RELIANCE

extends Totally Protected A-c. Motor line to 125 HP.





Reliance's proven Totally Protected design is now being extended thru 125 horsepower.

Now Totally Protected Motors will be available to you from 1 thru 125 hp. in new NEMA ratings.

Immediate delivery from stock today, 1 to 50 hp. Contact your Reliance representative for shipping schedules on other ratings.

B-1573

Write or call today for further information

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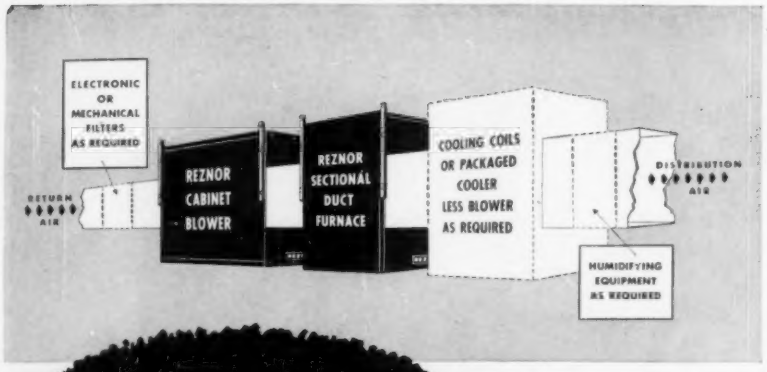
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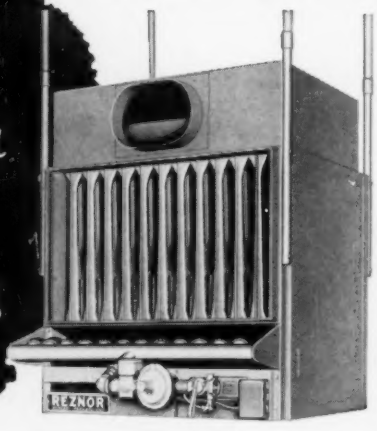
DISTRIBUTION AIR
HUMIDIFYING EQUIPMENT AS REQUIRED

How to Match a Heating System to Exact Job Requirements



Reznor sectional duct furnaces free the designer from the limitations imposed by packaged heating equipment . . . equipment which can't be *exactly right* for any one job because it has to be *good enough* for so many different jobs.

A heating or heating-cooling system designed around a Reznor duct furnace can be matched to exact job requirements. Each duct furnace is a compact, highly efficient heat exchanger with a full set of operating controls. All other components,—for air moving, cooling, cleaning and moisture control—are separately specified and installer-supplied. Only those components which are necessary on the particular job need be included, with each individually selected to fit that one job.

Sectional assembly (a completely new concept in duct heating equipment) completely eliminates the installation problems which formerly prevented the use of large capacity custom-engineered duct heating systems. With the Reznor Series DS sectional duct furnace, systems with capacities in excess of 2,000,000 Btu can be assembled on the job from sections weighing no more than 315 pounds. Each of four basic sections—150, 200, 250, and 300 thousand Btu—is complete with controls and is provided with its own built-in draft diverter, flue connections and mounting pipes.

If you aren't taking advantage of the design flexibility of Reznor sectional duct furnaces, you're missing a good bet on many of your commercial, industrial and institutional jobs. Don't delay getting all the details on this versatile line of heaters. Give your nearby Reznor distributor a call—today.

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wherever you are . . .

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EQUIPMENT DEVELOPMENTS

Continued

Instrument, 3¾ × 9 in., gives accurate readings of heat loss in watts, making it possible to select proper heating unit required for given space instantly, manufacturer says. Covers *U* factors from 0.06 to 1.13; based on 70 F temperature differences.

Gravity Roof Ventilator . .

. . .featuring new bearing design — *Triangle Engineering Co., Dept. HPAC,* 1301 *Ashland, Houston* 8.

Reduction of moving parts possible with new design; years of service obtained without lubrication, manufacturer says. Available in sizes 6 to 48 in. in galvanized iron, aluminum, copper, stainless steel.

Cleaning Aid . . .

. . .for boilers — *National Aluminate Corp., Dept. HPAC,* 6216 *W. 66th Pl., Chicago* 38.

"Nalco 85" removes high percentage of deposits, company says. Features cited by manufacturer: alkaline in nature; may be applied to operating boiler; cleans headers, other areas inaccessible to manual cleaning; disperses calcium carbonate deposits; does not require neutralizing after cleaning.

Temperature Switch . . .

. . .for water heaters — *Robertshaw-Fulton Controls Co., Grayson Controls Div., Dept. HPAC, Long Beach, Calif.*

Unit automatically shuts off flow of gas to main burner and pilot when

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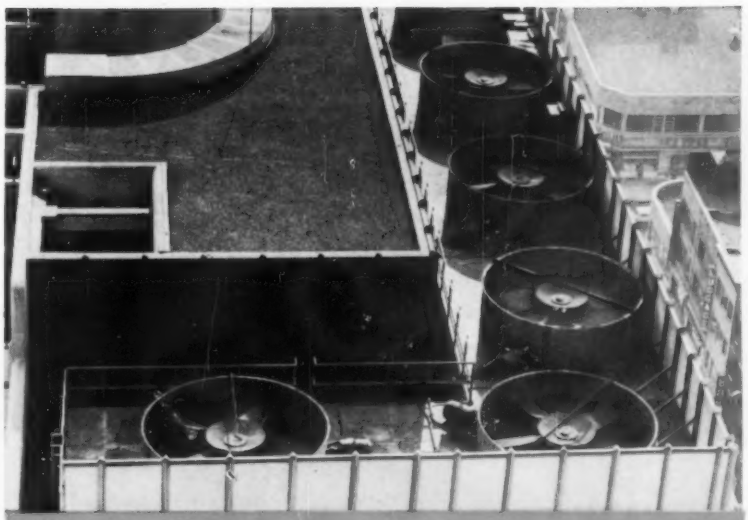

Waldron floating shaft couplings used on nine Phillips Cooling Towers

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. . . these features tell the difference . . .

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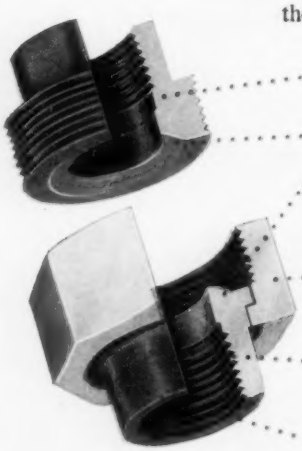

1. Designed to AAR dimensional specifications.
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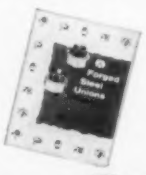

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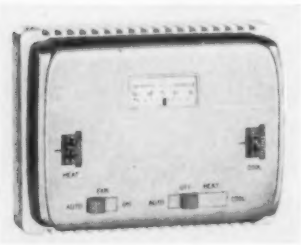
EQUIPMENT DEVELOPMENTS

Continued

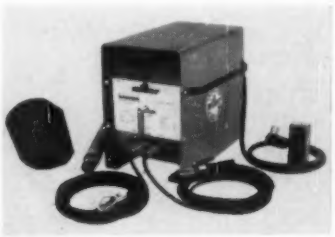
water temperature in heater tank becomes excessive or unsafe. Operates by breaking electrical current between thermocouple and magnetic coil which causes automatic pilot valve to shut off all gas, manufacturer says.



Thermostat . . .

. . . for either manual or automatic system changeover of air conditioning equipment — *General Controls Co., Dept. HPAC,* 801 *Allen Ave., Glendale* 1, *Calif.*

Four position selector switch may be operated by sliding one button. Another switch provides independent fan operation for air circulation without actuating heating or cooling equipment. Units are mercury switch equipped, feature brushed stainless steel cover providing accurate temperature sensing, lifetime finish, company says.



Utility Welder . . .

. . . with new movable shunt regulator — *Miller Electric Mfg. Co., Inc., Dept. HPAC, Appleton, Wis.*

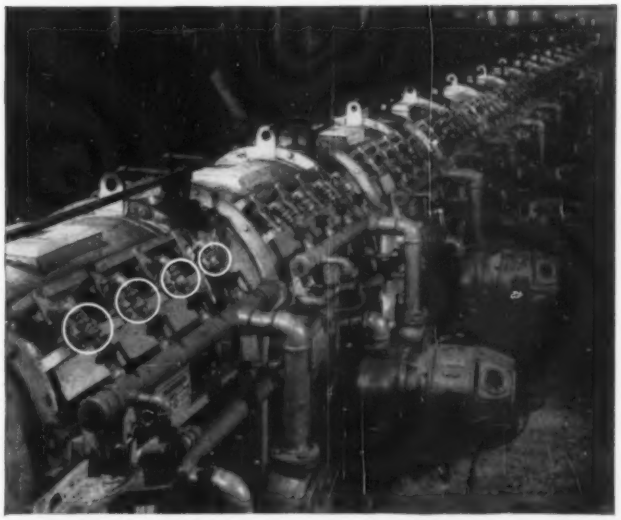
Unit provides continuous, precise fingertip current control; accurate amperage indicator on panel gives correct setting for each job, company says. Features cited: two welding current ranges; power factor correction; extra heavy gage steel body with baked enamel finish.

Tough jobs are a "cinch" for DRESSER Couplings

1

For Rapid Takedowns

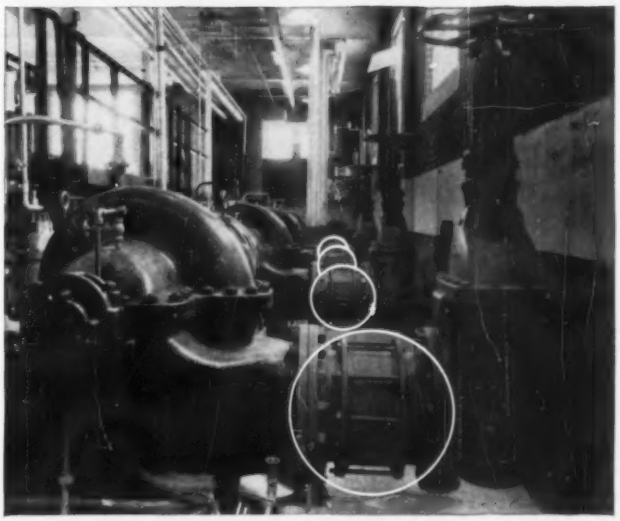
When piping on this huge industrial furnace manifold is removed for periodic cleaning of burners, down time is cut to a minimum. A few turns of a wrench disengages each of the over 100 Dresser Style 65 Couplings. They are easily reinstalled.



2

For Absorbing Vibration

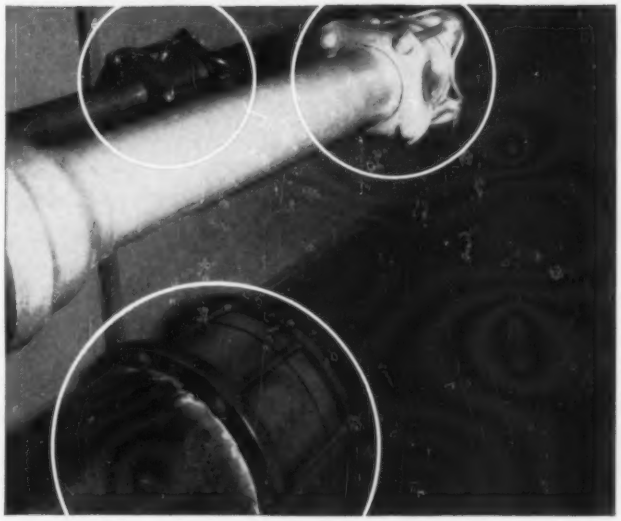
No matter how much these pumps vibrate, the Dresser Style 38 Couplings stay permanently tight. They're equipped with Dresser gaskets which absorb vibration, reduce noise. Style 38's are available for plain-end steel, cast iron or other pipe. Wrench-installed in but two man-minutes per bolt.



3

For Give-and-Take Flexing

At expansion joints in walls, anchored lines carrying liquids or gases must have joints that will *absorb* pipe movements. So Dresser Style 38 Couplings are used. They have resilient rubber gaskets that absorb expansion-contraction, yet stay bottle-tight and maintenance-free.



For fast, easy, sure pipe joining, see your local piping supplier for Dresser Couplings, Ells, Tees, Adapters, etc.

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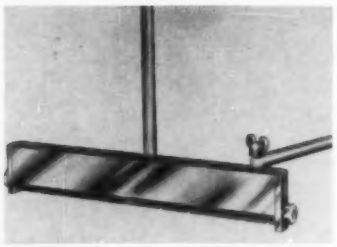
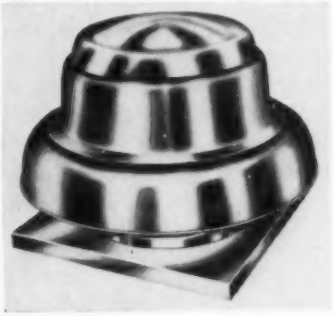


Hand Folder . . .

. . . designed to turn drive cleat folds on sheet metal duct or fittings — *Duc-Pac, Inc., Dept. HPAC, Baldwin St., East Longmeadow, Mass.*

Folder made of cadmium plated steel, designed to fold either ¼ or ½ in. folds on 2¼, 3¼, 5, 6, or 8 in. duct sizes. When not in use, handles can be turned flush with body for easy carrying in pocket or tool kit, manufacturer says.



Ventilators . . .

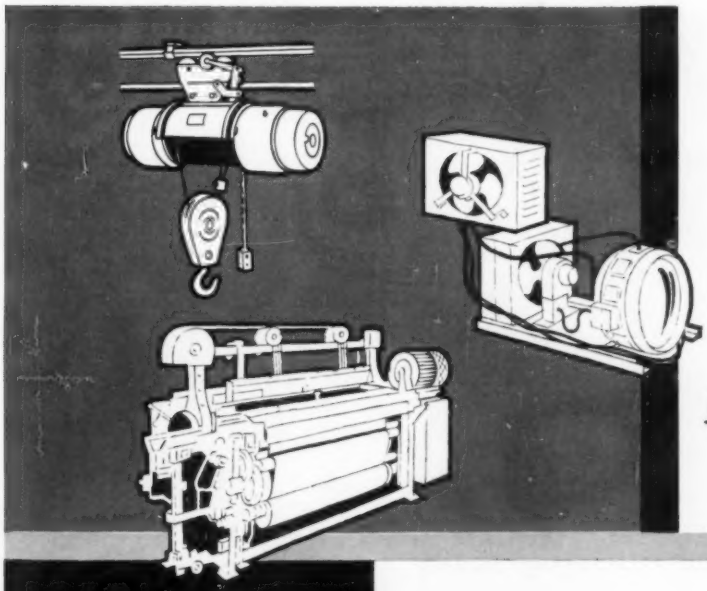
. . . designed to compliment modern architectural lines — *Penn Ventilator Co., Inc., Dept. HPAC, Goodman St. at Allegheny Ave., Philadelphia* 40.

"Domex" units housed in streamlined, spun aluminum. Can handle higher air volumes effectively, company says. Features cited: sparkproof fan wheels to 36 in. in diameter; accessibility of components; versatile direct, v-belt drive; quick installation.

Insulation Adhesives . . .

. . . for heating, air conditioning ducts, pipes — *St. Clair Rubber Co., Dept. HPAC, 440 E. Jefferson, Detroit* 26.

Features cited by manufacturer: better, neater job; 50 percent sav-



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EQUIPMENT DEVELOPMENTS

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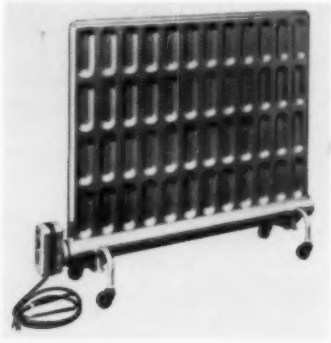
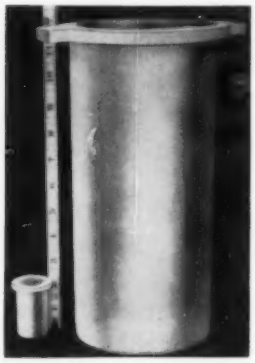
ings in labor cost; approximately 30 percent less for total job cost. "SC 4815" for bonding insulation to ducts; "SC 4851" for sealing lap seams on pipe covering.



Portable Heaters . . .

. . . designed for use in motels, other locations — *Skuttle Mfg. Co., Dept. HPAC, Milford, Mich.*

Units feature streamlined designs, low (190 F) surface temperatures. Sizes available are 500, 750, 1000 watt. All mounted on feet or casters, are thermostatically controlled.



Filter Cup . . .

. . . for liquids — *Porous Plastic Filter Co., Inc., Dept. HPAC, 30 Sea Cliff Ave., Glen Cove, N. Y.*

Unit, 12 in. high with 5½ in. OD and 5 in. ID, made porous in lower 7 in. only. Smaller unit is 2¼ in. high with 1¼ in. OD, 1 in. ID. Intermediate sizes available, also. Said by company to remove essentially all particles more than 3 microns in size from suspension.

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American has added six more AXIVANE fans and has equipped both the Convair and DC-7 hangars with this Joy cabin-ventilator system to replace larger, troublesome, less efficient portable blowers.

There is a Joy AXIVANE fan for any aviation, electronic or industrial application. For details, write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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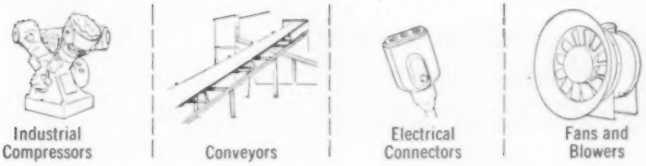

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EQUIPMENT DEVELOPMENTS

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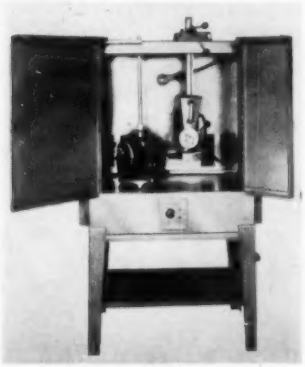


Compressor Opener . . .

. . . for automatically opening any shape hermetic compressor to 20 in. diameter — *Frankell Mfg. Co., Inc., Dept. HPAC, 1074 Home St., New York* 59.

Unit constructed of heavy gage metal, features two shatterproof windows for ful observation, motors completely enclosed with grease packed ball bearings, full length door hinges says company. Size, 40 × 24 × 40 in., operates on 115 volts, 60 cycles, and weighs approximately 275 lb.

Lock Seam Sealer . . .

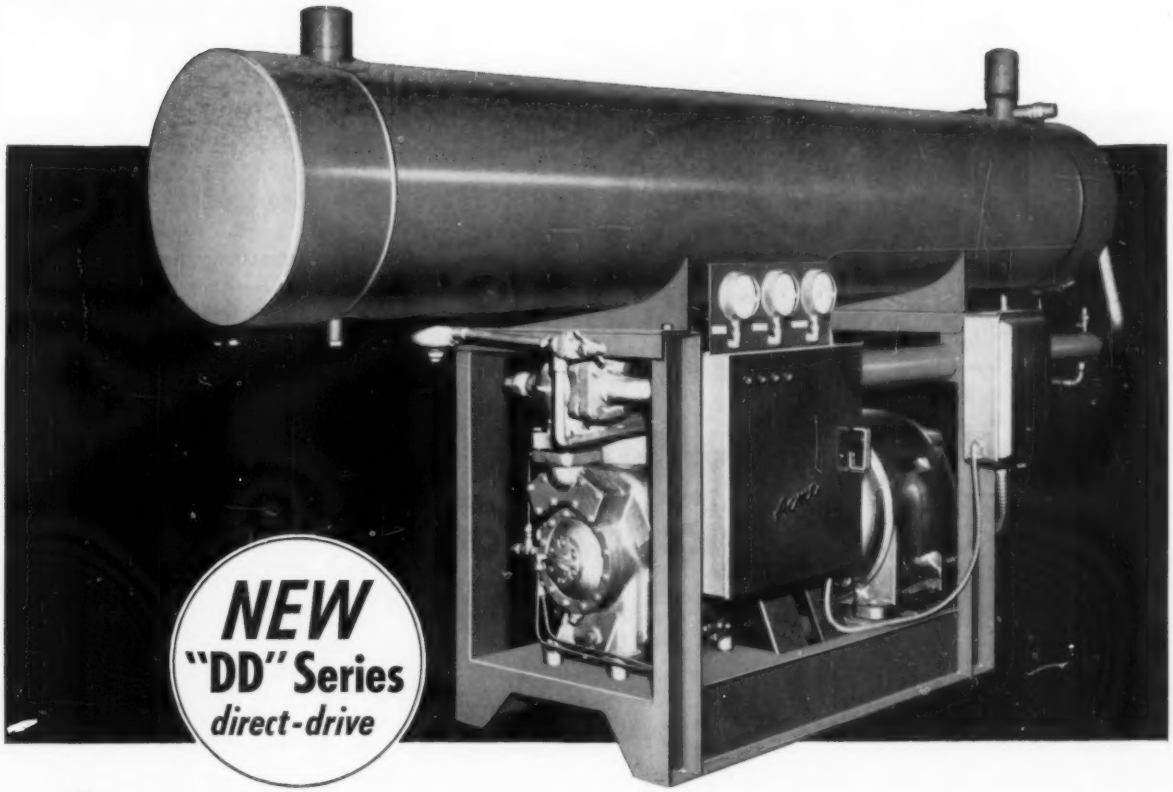
. . . with built-in guide — *E. V. Nielsen, Inc., Dept. HPAC, 128 Broad St., Stamford, Conn.*

Inside, outside lock seams flattened using only slightly raised edge of seam to guide on, company says. Units designed to close any size lock seam in metal gage.

Electrode . . .

. . . for use with small transformer power sources—*Air Reduction Sales Co., Div. of Air Reduction Co., Inc., Dept. HPAC, 150 E. 42nd St., New York* 17.

Model "90C" features tip that arcs immediately under low open circuit voltage, manufacturer says. Complete slag coverage maintained without arc interference. Physical properties of deposit: tensile strength, 76,400 psi; yield strength, 66,500 psi; elongation in 2 in., 24.5 percent; reduction of area, 51 percent.



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Acme's new DD Series Flow-Therm Liquid Chillers combine the advantages of close-coupled direct drive between compressor and motor with new engineering features that make these units the most advanced large-tonnage packages on the market today. Completely enclosed, tamper-proofed control panel with pilot lights to warn of open limit switches . . . Pilot-operated regulator valves for smooth, accurate refrigerant control and increased capacity range at low superheats . . . these and many other features are worth your investigation.

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With Acme you get a more complete range of models, with capacities to fit exact job requirements. This is possible because the Flow-Therm's chief components, famous Dry-Ex Chiller and Shell-and-Tube Condenser, can be tailor-made to match compressor performance exactly — combine operating economy with maximum capacity.

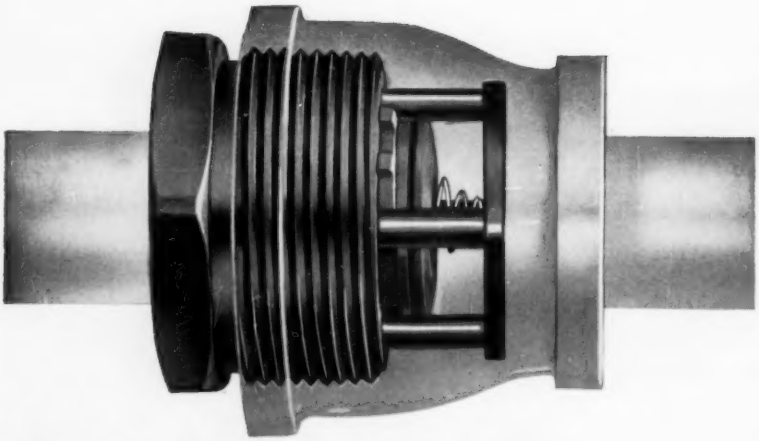
Acme Certificate of Performance issued on all Flow-Therm and Flow-Cold packaged liquid chillers, 3 through 125 tons.

To Get Your Copy of Acme's data-packed Flow-Therm catalog, just send us this coupon attached to your letterhead

ACME AIR CONDITIONING REFRIGERATION

Acme INDUSTRIES INC. Jackson, Michigan

Manufacturers of Quality Air Conditioning and Refrigeration Equipment since 1919



With this check valve and your imagination you can:

- *Cut inventory—drastically*
- *Reduce costs—substantially*
- *Be ready for any check valve emergency*

By combining a Durabla Basic Check unit with any standard pipe fitting you can make a complete check valve (see right).

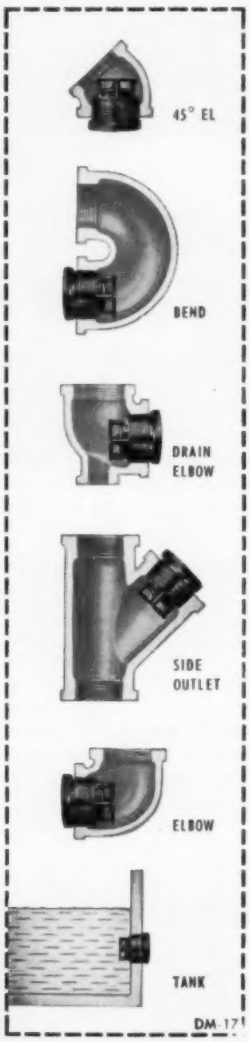
These unique check valves, through their interchangeability, reduce inventory sharply. You keep just the basic units on hand, and they're boxed, labeled, and ready for quick installation in any El, Tee, Cross, coupling, tank head or other vessel (such as a "dry can") as each job requires.

Durabla valves cut costs, since all you buy are the working parts. What's more, they operate perfectly in any position. This eliminates stocking of separate vertical and horizontal-operating valves, and permits installation without changes in existing lines, or costly "positioning" in new installations.

Made of stainless steel throughout, their versatility prepares you for any emergency. Durabla Check Valves will handle any liquid, gas or air—at all temperatures. They come in seven standard line sizes from ⅜" to 2". Write for details and bulletin HPAC 127.

DURABLA MANUFACTURING COMPANY

114 Liberty Street, New York 6, N. Y.



DURABLA

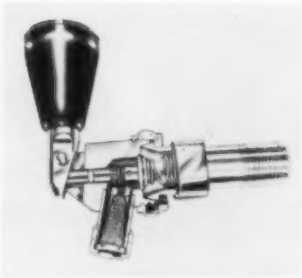
EQUIPMENT DEVELOPMENTS

Continued

Sealant . . .

. . . designed to keep nuts, bolts secure — *American Sealants Co., Dept. HPAC,* 103 *Woodbine St., Hartford* 6, *Conn.*

New "Loctite" liquid plastic comes in kit containing dispensing nozzle. Vibration does not loosen nuts, bolts after sealant is applied, yet they can be removed with ordinary tools, company says. Used also for sealing joints or porous welds in piping and process equipment against leakage.



Dispensing Faucet . . .

. . . for corrosive, flammable liquids — *Eco Engineering Co., Dept. HPAC,* 12 *New York Ave., Newark* 1, *N. J.*

Unit is corrosion resistant, constructed of 303 stainless steel with teflon o-ring seals. Provides both fluid, vapor tight seals over wide temperature range. Sealing accomplished by internal system pressure which eliminates seizure problems, company says. Guard prevents unit from being jammed in open position.

Electrode . . .

. . . made of chromium nickel — *All-State Welding Alloys Co., Dept. HPAC, White Plains, N. Y.*

Unit designed for very high alloy steels, tool and spring steels, pressure vessels, air hardenable steels, dies, nickel clad and carbon steels. Welded properties include: tensile strength, 120,000 psi; elong. in 2 in., 35 percent; hardness, 200 Brinell. Deposits cannot be heat treated, but can be work hardened to more than 180,000 psi tensile, company says.

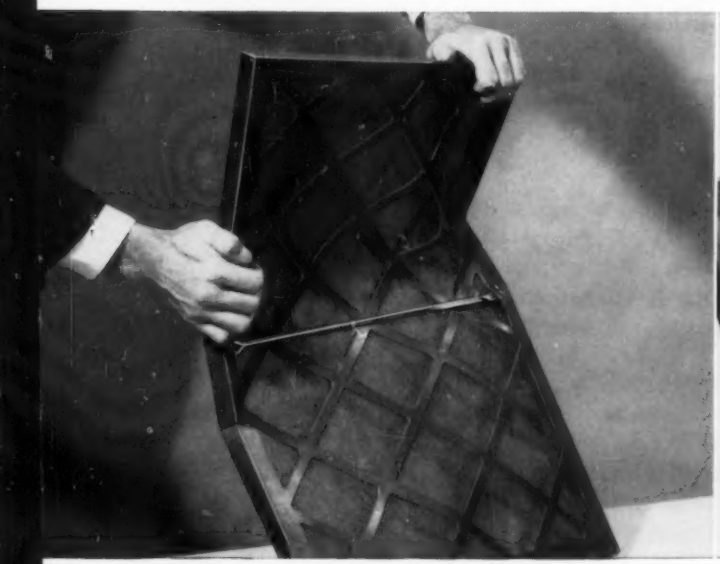
PROVE IT TO YOURSELF

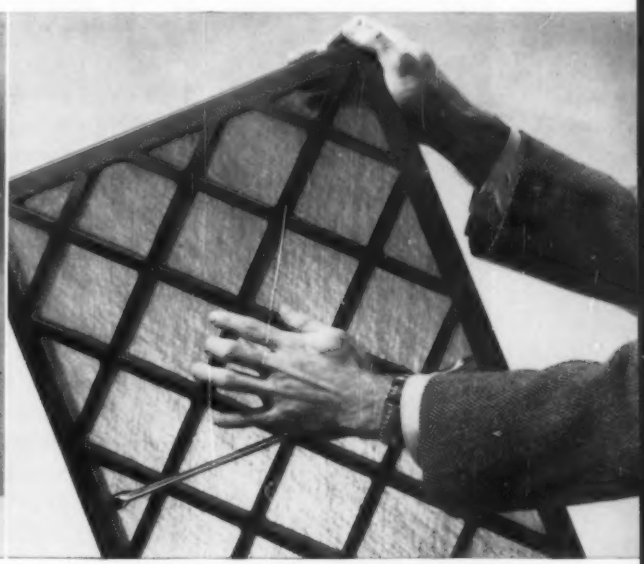
...how much stronger...how much safer

Glasfloss* fiber glass Safety-Grille* filters really are

*TRADE MARK

MAKE THESE TESTS...





1. Bend it—and the new Glasfloss Safety-Grille Filter bounces right back to its original shape. Old type metal-grille filters don't. Unless you re-bend them, they stay bent out of shape and can cut down filtering efficiency. Strong construction of Glasfloss Safety-Grille Filters means less chance of damage in transit, in storage, in handling.

2. Feel the grille edge—it's chipboard, and perfectly safe! No sharp edges—no cuts, no scratches to worry about!

For maintenance personnel, the new Glasfloss Safety-Grille eliminates any danger of cut hands or wrists and possible infection when changing filters.

Plus these features... Glasfloss Safety-Grille Fiber Glass Filters . . .

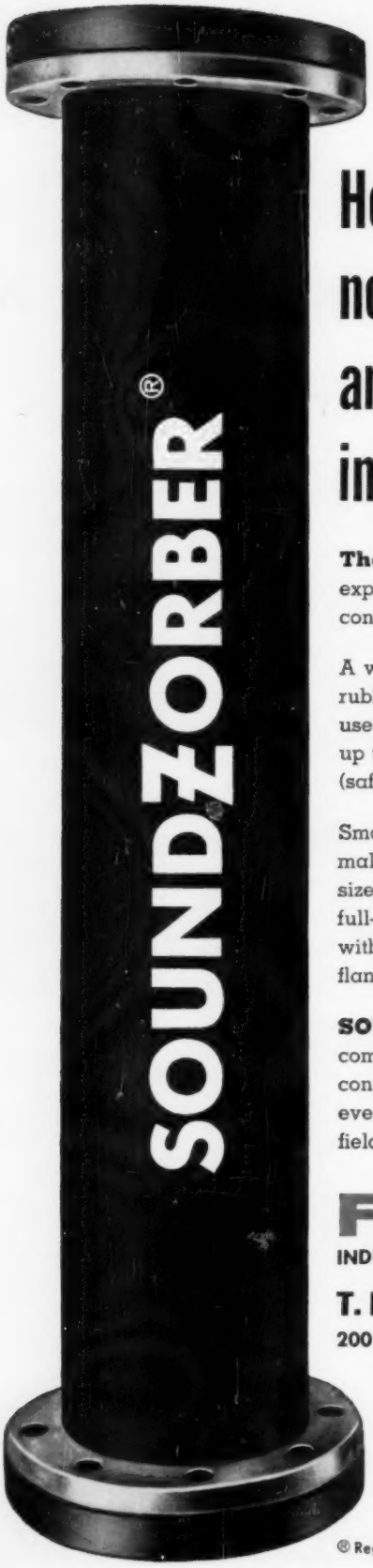
—have same available filtering area and initial pressure drop as old-type filters
—are tested and proven in service
—are approved by Underwriters' Laboratories, Inc.

Make these tests: Try PPG's new Glasfloss Fiber Glass Safety-Grille Filters in your heating and air conditioning systems. Get top filtering results! They're available in a complete range of sizes from your local distributor or PPG Warehouse.

A Product of Pittsburgh Plate Glass Company

Sales Offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh and St. Louis

FIBER PG GLASS PITTSBURGH PLATE GLASS COMPANY



How to stop noise, vibration and "hammer" in water lines

The original SoundZorber expressly designed for use in air conditioning water lines . . .

A wire-reinforced wrapped fabric rubber pipe, SOUNDZORBER can be used continuously in water lines at up to 250 psi working pressure (safety factor: 5 to 1).

Smaller sizes ½" to 3" available with male I.P.T. bronze fittings. Larger sizes available with integral full-faced rubber flanges backed up with Series 15 or Series 30 steel flanges. No metal-to-metal contact.

SOUNDZORBER is but one of a complete line of Finn vibration controls. Finn has control devices for every vibration problem in your field. Write for complete information.

FINN
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FINNFLEX VIBRATION CONTROLS

T. R. FINN & Company, Inc.
200 Central Ave., Hawthorne, N. J.

® Reg. U. S. Patent Off.

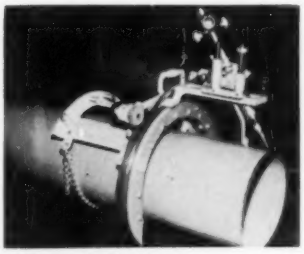
EQUIPMENT DEVELOPMENTS

Continued

Hammering Tool . . .

. . . designed to attach to ¼, ½ in. electric drills — *Hamer-Dril Co., Dept. HPAC, 514 Greenwich St., New York 13.*

Unit uses masonry drill bits of six different brands in wide range of sizes 5/32 to 1 in. Air cooled perforated steel handle will stay cool in hands all day, company says. Shock absorber protects electric drill.



Cutting Unit . . .

. . . engineered to eliminate inaccurate cuts, bevels on out-of-round pipe — *H & M Pipe Cutting and Beveling Machine Co., Dept. HPAC, 311 E. Third, Tulsa, Okla.*

Unit can be attached to company's standard pipe cutting, beveling machines. Roller rod assembly consists of rod fastened to body of attachment by means of set screw arrangement, small diameter wheel that is affixed to end of rod which travels outer circumference of pipe surface. Through action of spring, constant pressure is applied to roller rod which forces wheel to follow contour of pipe, company says.

Liquid Strainers . . .

. . . with self-cleaning feature — *Golden-Anderson Valve Specialty Co., Dept. HPAC, 1232 Ridge Ave., Pittsburgh 33.*

"You mean you get both air *and* light from the same unit?"

"That's right. It's the new **MULTI-VENT TROFFER** The air diffuser is completely concealed in the flush light fixture!"

There's more to the new **MULTI-VENT TROFFER** than meets the eye!

It combines a great advance in gently diffused, draft-free air conditioning, with modern, highly efficient lighting at a substantial savings in cost!

Complete concealment of the air diffuser within the handsome light fixture means freedom for the architect to design clean, uncluttered ceilings, greatly simplified mechanical planning for the engineer and . . . for the contractor . . . faster, easier field installation.

Write for detailed literature and the name of the representative in your area.

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Multi-Vent® by The Pyle-National Company—Trofferlite by Benjamin Electric Mfg. Co.

SALES AND ENGINEERING REPRESENTATIVES IN PRINCIPAL CITIES OF THE UNITED STATES AND CANADA

NOW...

Set a ¼" stud in steel or concrete with one light tap!

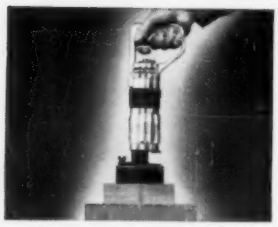
ONLY $39.95

NEW Remington "Mighty-Mite" STUD DRIVER

HERE'S the new handy-sized cartridge-powered Remington stud driver that handles all fastening jobs requiring a ¼" stud. "Mighty-Mite" sets a stud a minute—with no pre-drilling or outside power required, and it's yours for only $39.95.

"Mighty-Mite" is compact and easy to operate. Simply unscrew the upper assembly, insert the 22 caliber cartridge with the desired ¼" stud, and you're ready to anchor wood sections or steel fixtures to concrete or steel! One light tap of a hammer or mallet on the firing pin and your stud is set firmly in place, straight as an arrow.

We have all the facts about the new Remington "Mighty-Mite" in an illustrated free booklet. Included are many applications, with pictures, of this versatile stud driver that pays for itself in just a few fastenings. Send for your copy today by mailing the coupon below.



Model 455A Remington Stud Driver — medium and heavy-duty companion tool to the low-cost "Mighty-Mite."

Industrial Sales Division, Dept. 1712
Remington Arms Company, Inc.
Bridgeport 2, Conn.

Please send me your free booklet which shows how I can speed the job and save with the new Remington "Mighty-Mite" Stud Driver.

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*Firm*_____

*Address*_____

*City*_____ *State*_____

Remington

DUPONT

EQUIPMENT DEVELOPMENTS

Continued

Units designed for straining fluids without interrupting flow for cleaning of screen. Since screens are constantly kept clean, small perforations of 0.023 in. diameter are used which stop smallest particles, company says. Designed for water pressure to 125 psi with motors suitable for 110 or 220 volt, 60 cycles a-c.

Accessory Control . . .

. . . designed for service with "Aircospot" gun in arc spot welding of light gage metal — *Air Reduction Sales Co., Div. of Air Reduction Co., Inc., Dept. HPAC,* 150 *E. 42nd St., New York* 17.

Control functions to automatically regulate cooling rate of "Aircospot" welds. Arc intensity drops to lower level before it extinguishes. Weld cools more slowly, which minimizes or eliminates tendency toward weld cracking in certain metals when they cool rapidly, company says.

Mist Collector . . .

. . . which allows dropper pipe to function as enclosure for filter and preseparator — *Dustender Co., Dept. HPAC,* 3627 *Pontiac Rd., Ann Arbor, Mich.*

"Mistender" designed for overhead installation to save floor space, uses slightly larger than usual pipe to enclose filter that is adapted for separating mist from air stream and returning it to source as re-usable

KEEP IT CLEAN by Phil Tration

"On-the-job" blood purification is not a recommended use for Dollinger Staynew Filters . . . but who knows, maybe our cartoon will start a new trend.

After all, everyone in industry today is looking for new and more efficient ways of doing things. And, when it comes to new ideas in filtration, Dollinger is ready, willing, and able. Whether you want to protect machines or processes from damage caused by dust, dirt, oil, grease, or other foreign matter, Dollinger Engineers will provide a Staynew filter to do the job efficiently and economically. Chances are your filtration problem has already been solved and there is now a *standard* Staynew Filter to handle it.

ELECTRO-STAYNEW PRECIPITATOR

Staynew Ventilating Filters—Among the complete line offered by Dollinger you will find one that meets your needs exactly. All types—Viscous Panel, Dry Panel, Electro-Static Precipitators and Automatic Filters. Illustrated is the Electro-Staynew Precipitator which removes 90% of all air-borne dirt, smoke, dust, pollen and oil mist. It's completely self-contained . . . Ionizer and Collector in one unit. 1200 to 1800 CFM. Larger capacities in multiple units. Ask for Bulletin 400. Dollinger Corporation, 9 Centre Park, Rochester 3, N. Y.

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FILTERS

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS • ELECTROSTATIC FILTERS • MIST COLLECTORS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS • VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS HIGH PRESSURE FILTERS • AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

they stopped shouting

"Shut that ---- door!"

"As soon as the trucks had gone, the whole shipping room used to yell 'Shut that —— door!' . . . that is, until we installed that big Wing Door Heater. Now, nobody notices whether the door is open or closed, for the room is just as comfortable either way."

That's the experience of every user of Wing Door Heaters. As soon as the doors are opened in cold weather, they automatically go into action, throwing down a curtain of hot air that stops the chilly breezes right at the doorway. They save time and money by eliminating work slow-down and employee complaints. They cost relatively little to operate, because they run only when you need them.

Do you have an "open door" problem? Better send for Wing's bulletin on Door Heaters.

L. J. Wing Mfg. Co. 140 Vreeland Mills Road · Linden · N. J.
DIVISION OF AERO SUPPLY MFG. CO. INC. In Europe: WANSON, Haren Nord, Brussels, Belgium

Wing

·HIGH VELOCITY·
DOOR HEATERS

FANS • UNIT HEATERS • DRAFT INDUCERS • BLOWERS • TURBINES

EQUIPMENT DEVELOPMENTS

Continued

condensate, company says. Pre-separator causes most of mist as well as solids to "throw out" and also be removed as condensate through contact with inside surface of pipe. Has continuous duty 1/3 hp motor driving fan with rated capacity of more than 500 cfm.

Welding Gun . . .

. . . of light weight design—*Nelson Stud Welding Div., Gregory Industries, Inc., Dept. HPAC, Lorain, Ohio.*

"NS-10" welds all studs through ½ in. in diameter, weighs less than 4 lb, measures 9 in. long. Unit increases stud welding productivity, decreases operator fatigue, is easy to maintain, manufacturer says.

Equipment Briefs . . .

CUTOFF MACHINE for nonferrous tubing — *Walter P. Hill, Inc., Dept. HPAC, 22183 Telegraph Rd., Detroit* 19. Unit designed to produce accurate, burrfree lengths of tubing at extremely high production rates, company says. Additional attachments for machine provide fully automatic cutoff unit that will straighten, temper, roundform tubing from coiled stock.

INSULATING GLASS UNITS in sizes to 50 sq ft — *Pittsburgh Plate Glass Co., Dept. HPAC, 632 Fort Duquesne Blvd., Pittsburgh* 22. Available in metal edge, new product made of ¼ in. "Solargray" plate glass, ¼ in. regular plate glass with either ½ or ¼ in. air space. Glare

CRESCENT ARMORED MULTITUBE

—with

Cabled Tubes

For More Profit on your Instrument and Control Tubing Jobs

FOR CORROSIVE LOCATIONS a thermoplastic sheath is used in combination with the steel armor.

CRESCENT ARMORED MULTITUBE* is a group of tubes *spirally* cabled together. Instead of handling a number of individual tubes, you have a single unit to work with. One tube in each layer is a bright blue color, which makes identification of any tube at both ends an easy matter.

Users report *savings in installed cost* of from two to five times the cost of CRESCENT ARMORED MULTITUBE as compared with the old method of using single tubes. Using the MULTITUBE system will result in fewer connections and fittings, lower cost for supports or racks, ease of mounting and less space.

The spiral cabling of the tubes prevents distortion when the entire assembly is bent on a short radius. The tubing assembly is protected by a flexible, interlocked galvanized steel armor, or by a tough corrosion-resistant thermo-plastic sheath. This product is licensed under U. S. Patent 2,578,280.

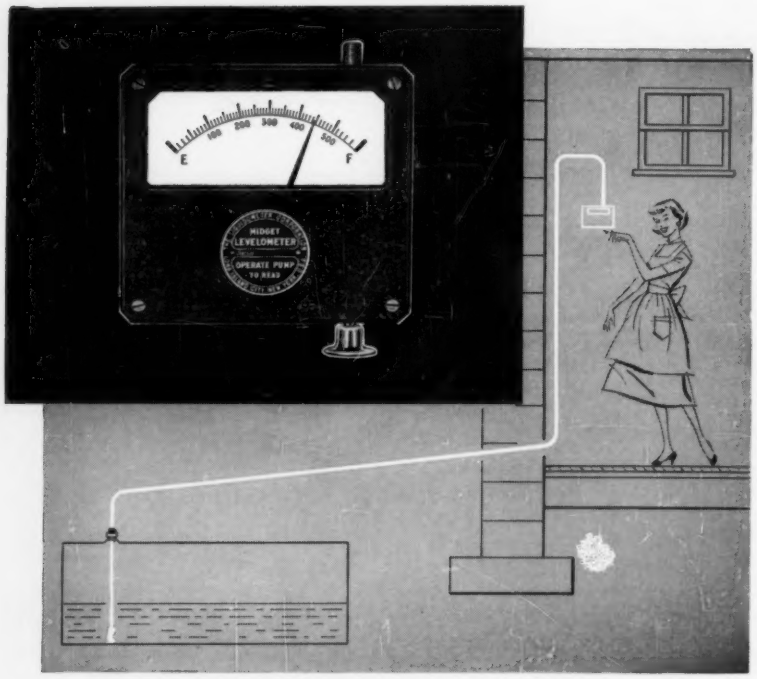
*Registered Trade Mark

Furnished in from 2 to 37 Tubes of Copper, Aluminum, Steel, Polyethylene
Also Special Construction for Underground Runs

SEND FOR TECHNICAL BULLETIN NO. 356-I GIVING COMPLETE INFORMATION

CRESCENT INSULATED WIRE & CABLE CO.

Trenton 5, New Jersey



LOW-PRICED...QUALITY MIDGET LEVELOMETERS

GIVE DEPENDABLE INDICATION OF TANK CONTENTS

Midget Levelometers provide home owners and plant engineers with reliable, easy-to-read, trouble-free indication of fuel supply. The dangers and inconvenience of old-fashioned dip sticking and taping methods are eliminated. In the plant, fire and labor hazards are cut . . . costly shut-downs caused by lack of fuel are avoided.

Levelometers operate on an adaptation of the hydrostatic principle. They establish a balance between the height of the liquid to be measured and an indicator. Dial type indication provides maximum readability. Levelometers are precision built, rugged, easy to install and constructed of the finest materials. Approved by UL, FM and BSA, New York, they are used for gaging fuel oil, diesel oil, gasoline and a variety of other liquids.

Levelometers are available in several sizes for a wide variety of applications. For complete information write Dept. A

LIQUIDOMETER INSTRUMENTS

THE LIQUIDOMETER CORP.

SKILLMAN AVENUE AT 36TH STREET, LONG ISLAND CITY 1, N.Y.

EQUIPMENT DEVELOPMENTS

Continued

control for visual comfort without shades provides better visibility, more complete indoor-outdoor integrations, company says.

AIR CONDITIONERS with changeable picture panels to conceal control dials — *Whirlpool Corp., Dept. HPAC, St. Joseph, Mich.* Among 15 new units are plug-in models which operate on 115 volt circuits. Cooling capacity ranges 575 to 1100 sq ft. New mobile electric dehumidifier, four central air conditioning systems also included in 1958 product line.

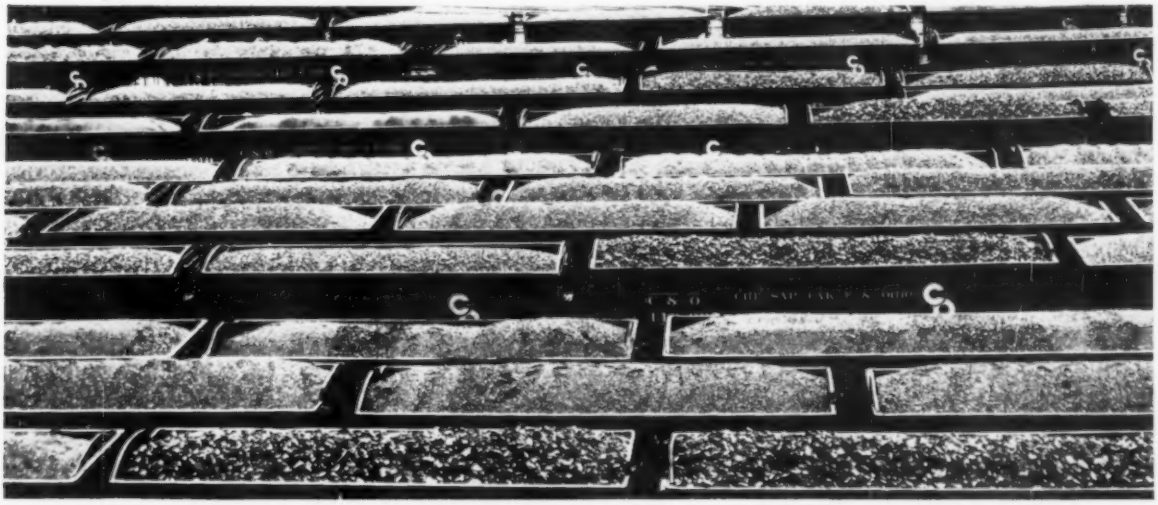
RUST PREVENTIVE designed to neutralize sulfur acids formed when water condensation is trapped — *J. A. Sexauer Mfg. Co., Inc., Dept. HPAC,* 2503-05 *Third Ave., New York* 51. "No-Corrode" simultaneously stops electrolysis, corrosion; prevents leaks; prolongs life of fuel oil, storage tanks, manufacturer says. Available in tablet form; each six tablet pack treats 1500 gal tank.

FLEXIBLE LAMINATE SYSTEM designed to provide tough, shock resistant surface — *Twinsburg-Miller Corp., Dept. HPAC, Twinsburg, Ohio.* System is chemically resistant to common acids, alkali, other materials, company says. Suitable for chemical lining of tanks, vessels; plastic solder, weld; piping repairs.

INTERVAL TIMERS with switching system designed to allow high accuracy over long range timing intervals — *A. W. Haydon Co., Dept. HPAC, Waterbury, Conn.* Units available with either chronometrically governed d-c or synchronous a-c motors. Hermetically sealed adjusting knobs on fronts of units allow rapid, accurate settings of calibrated dials within glass windows, manufacturer says. ‡

WHY CHESSIE'S RAILWAY IS FIRST IN COAL

SUPERIOR COAL. This large battery of washing tables is an example of the modern methods used by producers on the C&O. The naturally superior coals found in the Chessie area can be sized and processed to meet your own particular requirements.

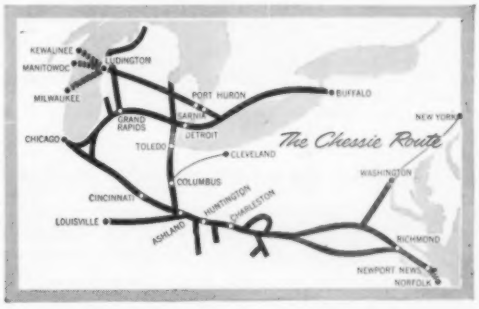


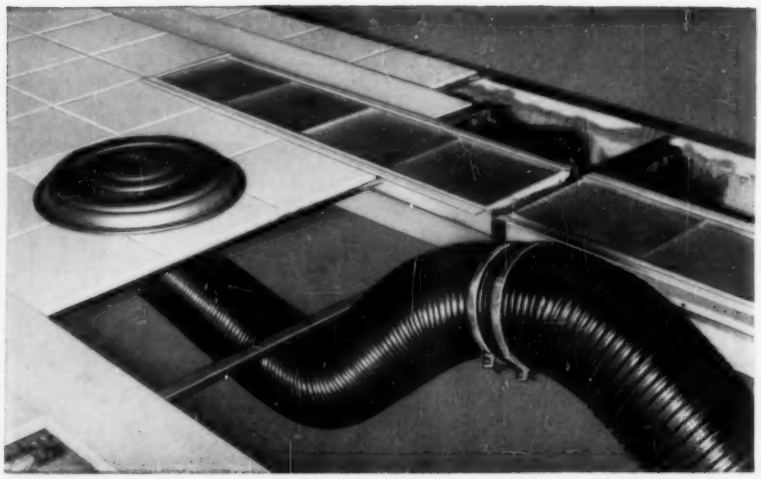
SUPERIOR SERVICE. With the world's largest fleet of coal cars, C&O's accelerated repair program continues to keep them in better than 99% good order. Plenty of cars, plus ample motive power and modern yards and signal systems assure prompt and efficient service.

For dependable sources of top quality coals, contact coal producers on the C&O. And for specific help in meeting your own fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake and Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

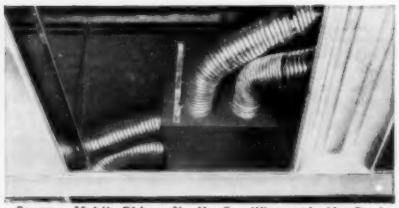




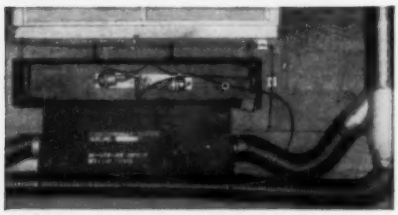
Indiana Nat'l Bank Bldg., Indianapolis—Wiremold Air Duct runout from branch duct to ceiling diffuser.

READILY RELOCATED

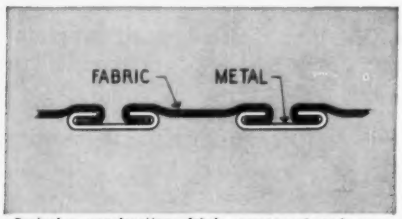
Flexibility of Wiremold Air Duct lets you move diffusers anywhere, anytime



Socony Mobil Bldg., N. Y. C.—Wiremold Air Duct "octopus" in a high-velocity air conditioning system.



Cuyahoga County Bldg., Cleveland—Wiremold Air Duct connects hot and cold risers to underwindow units.



Exclusive construction—fabric component and supporting steel spiral are mechanically interlocked.

Wiremold Air Duct, the flexible connector, helps make air conditioning systems versatile. It provides a simple way to adjust for any variations from initial plans, or changing tenant requirements. And both diffuser and Wiremold Air Duct can be moved without disturbing permanent equipment.

Made by an exclusive process that mechanically interlocks the fabric with the supporting steel spiral, there is no glue to dry out and cause duct failure. As a result, Wiremold Air Duct provides long life and good performance. Its light weight makes it easy to handle — especially important in cramped quarters.

other advantages

- **good air flow with minimum pressure loss**
- **no air leakage at normal operating pressure**
- **meets National Board of Fire Underwriters requirements**
- **compensates for misalignments between connections**
- **allows for future relocation of units**
- **acts as a vibration damper**
- **easy to cut, fit and install**

SEND FOR FOLDER NO. 591 for further information on Wiremold Air Duct.

WIREMOLD® FLEXIBLE AIR DUCT

THE WIREMOLD COMPANY, HARTFORD 10, CONNECTICUT

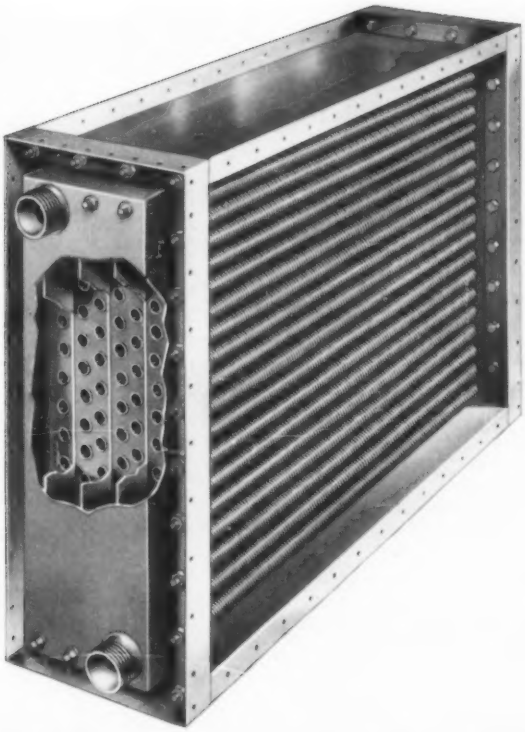
RECENT TRADE LITERATURE . . .

▸ *AIR CONDITIONERS*—Two catalogs, EMS-5715EC and EMS-5715 WCC, describe air conditioners in two series. First booklet covers new seven model line of conditioners featuring sectional construction for use where space is limited. Second bulletin covers 7½ through 60 hp packaged conditioners with water cooled condensors which company says offer maximum capacities at minimum cost. Tables, ratings, capacities, charts, pictures included. *Drayer-Hanson, Div. of National-U.S. Radiator Corp., Dept. HPAC,* 3301 *Medford St., Los Angeles* 63.

▸ *AIR DRYERS* — New 4 page bulletin 857 describes dryers with capacities to 125 standard cfm at 90 F and 100 psig. Units will automatically lower dewpoint of air so that moisture will not condense in delicate instruments or form ice crystals, company says. Illustrations, specification table included. *Anders Lykens Corp., Div. of Milton Roy Co., Dept. HPAC,* 1300 *E. Mermaid Ln., Philadelphia* 18.

▸ *CENTRIFUGAL FANS* — Operation, specifications, performance data of polyvinyl chloride centrifugal fans presented in new 4 page brochure. Units designed for blower installations requiring high chemical resistance and wide temperature range. Models, 9½ to 40 in., resist acids, alkalis, salt solutions, alcohols, company says. Capacities available 140 to 15,000 cfm. *Chicago Blower Corp., Dept. HPAC,* 9863 *Pacific Ave., Franklin Park, Ill.*

▸ *CUTTING UTILITY COSTS* — New service designed to reduce costs of electricity and gas purchases made by businesses explained in brochure entitled *Cutting Utility Costs.* Methods used by consultants to aid clients highlighted in literature. *American*



AEROFIN TYPE R REMOVABLE-HEADER WATER COILS

- **Complete Drainability**
- **Easily Cleaned**
- **High Heat Transfer**

Completely drainable and easily cleaned, Aerofin Type "R" coils are specially designed for installations where frequent mechanical cleaning of the inside of the tubes is required.

The use of 5/8" O. D. tubes permits the coil to drain completely through the water and drain connections and, in installations where sediment is a problem, the coil can be pitched in either direction. The simple removal of a single gasketed plate at each end of the coil exposes every tube, and makes thorough cleaning possible from either end.

The finned tubes are staggered in the direction of air flow, resulting in maximum heat transfer. Casings are standardized for easy installation.

Write for Bulletin No. R-50.

AEROFIN CORPORATION

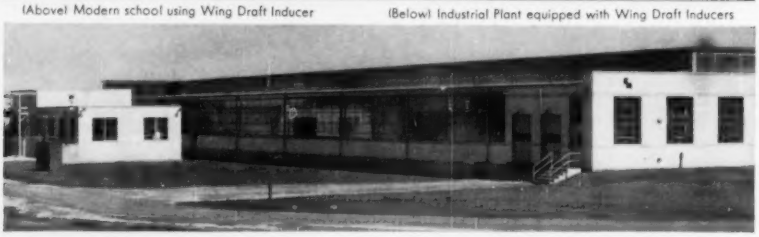
101 Greenway Ave., Syracuse 3, N. Y.

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

(Above) Suburban Apartment House using Wing Draft Inducers

(Above) Modern school using Wing Draft Inducer

(Below) Industrial Plant equipped with Wing Draft Inducers



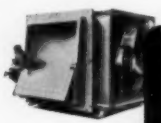
Look! — no chimneys

MODERN buildings are now being designed without tall obtrusive chimneys marring their clean horizontal lines. This refreshing trend is made possible by the use of Wing Draft Inducers in the boiler or furnace room, eliminating the necessity for stack or chimney.

But that is only one of the advantages of Wing Draft Inducers. Another is the substitution of positive, uniform, adequate draft at all times, regardless of wind, weather or load variations.

Savings through these advantages are impressive. Write for a copy of Bulletin I-57 and see for yourself.

L. J. Wing Mfg. Co. 140 Vreeland Mills Road · Linden · N. J.
DIVISION OF AERO SUPPLY MFG. CO. INC.



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DRAFT INDUCERS

FANS • UNIT HEATERS • DRAFT INDUCERS • BLOWERS • TURBINES

RECENT TRADE LITERATURE

Continued

Utility Cost Consultants, Dept. HPAC, 15 Park Row, New York 38.

▸ *DIAL THERMOMETERS* — New catalog 225-C describes dial thermometers made with 3 in., 4½ in. diameter dials. Units actuated by bimetallic helix that responds rapidly to temperature changes, company says. Said to resist dust, moisture, fumes. *Moeller Instrument Co., Dept. HPAC, 132nd St. & 89th Ave., Richmond Hill 18, N. Y.*

▸ *DRAINAGE PUMPS* — Electrically driven drainage pumps designed for industrial use described in bulletin B-1100. Suitable either for portable service or permanent installation, units handle water high in solid content and pump down to 1 in. levels, company says. Fabricated of aluminum, stainless steel, bronze. *Sump Pumps, Inc., Dept. HPAC, Stamford, Conn.*

▸ *DUCTS* — Eight page manual describes new heating duct material for radial, perimeter heating. Information given on "Ceramiduct" with detailed specifications, installation plans. Design data for duct systems includes: floor heat loss factors; recommended duct sizes; minimum register free areas required for buildings. *Straitsville Brick Co., Dept. HPAC, New Straitsville, Ohio.*

▸ *ELECTRIC DRILLS* — New 4 page bulletin features series of reversible heavy duty electric drills. Specifications of "EN" series of ⅜, ¾, ⅞, 1 in. portable units given. Details of "EL," "EJ" electric drill series, screwdriver nutsetters, impact wrenches also included. *Thor Power Tool Co., Dept. HPAC, Prudential Plaza, Chicago 1.*

▸ *FASTENERS* — New 52 page catalog includes illustrations, thread and design specifications of 40 basic fastening devices. Included are

RECENT TRADE LITERATURE

Continued

screws, bolts, nuts, washers, rivets. Engineering data relating to composition, properties, applications, weights of stainless steels provided. *Allmetal Screw Products Co., Inc., Dept. HPAC, 821 Stewart Ave., Garden City, N. Y.*

▸ *FASTENERS* — New 12 page booklet 8-414 describes fasteners and their application. Nomenclature, shear and tension values, hole size recommendations included. Dimensional information covering both metal to metal and wood to metal uses tabulated. *Huck Mfg. Co., Dept. HPAC, 2480 Bellevue Ave., Detroit.*

▸ *FUEL OIL TREATMENT* — Advantages of sludge disintegration, dispersal in storage tanks and equipment described in new 2 page bulletin. Treatment dissolves sludge into combustible material, emulsifies condensate water as protection against rust and corrosion, company says. Other features cited by manufacturer: descreases carbon rings, deposits in oil burner nozzles; dissolves sludge formations in storage tanks; eliminates sputtering caused by large globules of water entrained in fuel oil. *North American Mogul Products Co., Dept. HPAC, Standard Bldg., Cleveland 13.*

▸ *GAS BURNER* — New 2 page bulletin describes "Jet Power" gas burner designed for oil burner replacement. Pilot provides 100 percent shutoff without limiting manifold capacity; main burner valve cannot be opened while pilot is being lighted, company says. Among other features cited: quietness, safeness, ease of servicing. *Auburn Burner Co., Dept. HPAC, Edgerton, Ohio.*

▸ *GATE VALVES* — New 4 page booklet 561 has details of "King Clip" gate valves for 125, 150 lb service applications. Tables of pres-

Contractor: Mannen & Roth, Cleveland, Ohio

When you're up in the air about fastening . . . use *Ramset*®!

Fastening ducts to the framework of a new building can be done hours, even days, faster with RAMSET. RAMSET did this job 80% faster, and saved this contractor $24.00 per day, per man!

RAMSET reaches hard-to-get-at places faster, easier. It's powder-actuated. No bulky power lines or heavy equipment to drag around. Power and fasteners are conveniently carried in the operator's pocket. Ideal for ladder and scaffold work, RAMSET's one-hand operation results in less fatigue.

If you need fasteners in a hurry, your RAMSET dealer will deliver them to you "on-the-job". He's listed under "Tools" in the phone book. Also ask about SHURE-SET® hammer-in fastening tool for light-duty fastening (it's a RAMSET companion tool).

Write now for new catalogs.

***Ramset* Fastening System**

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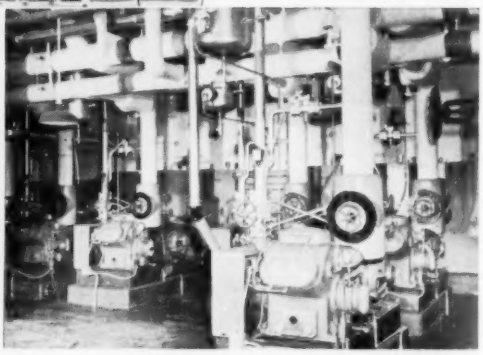
OLIN MATHIESON CHEMICAL CORPORATION

12109-L BEREA ROAD • CLEVELAND 11, OHIO

Famous Neil House of Columbus, Ohio, chooses Vilter Air Conditioning to provide their guests with controlled comfort year 'round.

Shown are the five Vilter six-cylinder ammonia compressors which provide most of the refrigeration. Other Vilter equipment includes: evaporative condensers, Pakicer, for their ice requirements in kitchen and bottle beverage room service, shell and tube brine coolers to supply cold brine for the kitchen refrigerators and cold storage rooms, and air conditioning units. Complete automatic control is provided.



Famous Convention Hotel Enjoys VILTER Air Conditioning

● The Neil House, one of the outstanding convention hotels of the nation located in Columbus, Ohio, believes wholeheartedly in the drawing powers of air conditioning. A satisfied Vilter customer since 1939, it has continued, through the years, to extend its air conditioning facilities . . . Vilter units being specified in each case.

Prominent among Vilter equipment are the feature-packed VMC ammonia compressors which are installed in the power plant across the street—their compact design insures more capacity in less space . . . assure lower maintenance cost because of interchangeability of components . . . provide efficient, economical performance, guaranteed for a long life. Your refrigeration dollar buys more in a Vilter VMC.

Installed on the roof of the power plant are Vilter Evaporative Condensers. They save you 90 to 95% in water costs . . . provide low pumping costs, eliminate waste water disposal problems, and may be installed indoors or out. Vilter Evaporative Condensers mean lower cooling costs.

See your nearest Vilter distributor for engineering assistance in designing an air conditioning and refrigeration system to your needs.

Write to The Vilter Manufacturing Company, Dept. F-704, 2217 S. First Street, Milwaukee 7, Wisconsin, for helpful literature.

Bulletin 732 Vilter Evaporative Condensers

Bulletin 631 Vilter Uni-Chillers

Bulletin 429 Vilter VMC Freon Compressors

Vilter®

REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin

Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

RECENT TRADE LITERATURE

Continued

sure ratings, dimensions, parts identification given. *Lunkenheimer Co., Dept. HPAC, Box 360, Cincinnati.*

▶ *HEATING EQUIPMENT* — New 4 page brochure 12, *Care and Maintenance of Steam and Hot Water Unit Heaters*, presents information on caring for unit heating equipment. Among topics discussed: low pressure gravity systems; vacuum systems; high pressure systems; branches from steam supply mains; strainers. Maintenance procedures cover motors, heating elements, fans, casings, traps, check valves. *Air Moving & Conditioning Association, Dept. HPAC, 2159 Guardian Bldg., Detroit 26.*

▶ *INDUSTRIAL HEATERS* — New 4 page bulletin describes industrial heaters rated 400,000 to 2 million Btu. Illustrations, engineering data included. *Lennox Industries, Inc., Industrial Heater Div., Dept. HPAC, 1701 E. Euclid Ave., Des Moines.*

▶ *MERCURY RECEIVERS* — New 2 page bulletin describes "Mercureceivers" designed to prevent loss of mercury from manometer tubes, to smooth out pressure impulses and fluctuations, to make possible steady average pressure readings. Units, fabricated of moly or stainless steel, suitable for mercury normally present in 45 in. manometer tubes, company says. *Chemiquip Co., Dept. HPAC, 460 W. Broadway, New York.*

▶ *MOTORS* — New 4 page booklet 2050 describes vertical hollow shaft motors designed for shallow, deep well turbine pump applications. Features cited by manufacturer: "climatized" enclosure providing all weather security; improved thrust bearing design; metered lubrication; protected bearing system. Installation methods, maintenance features

RECENT TRADE LITERATURE

Continued

highlighted. *Louis Allis Co., Dept. HPAC, 427 E. Stewart St., Milwaukee* 1.

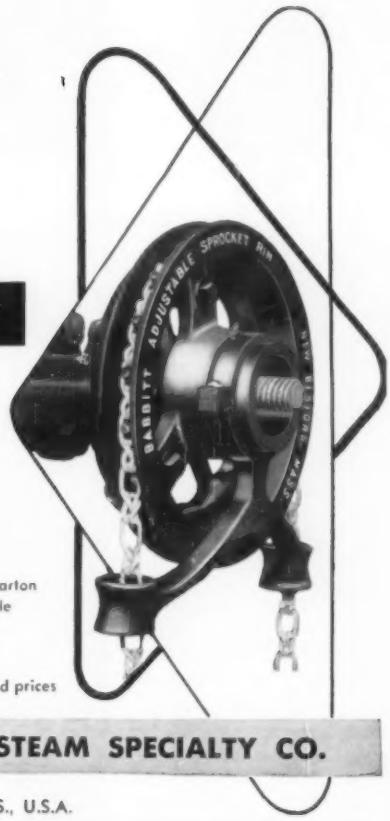
▶ *PIPE* — New 30 page catalog contains information on general characteristics of polyvinyl chloride pipe, its properties, applications, installation techniques. Chart classifies corrosion resistance ratings of "Type 1," "Type 2" pipe, low carbon steel, three classes of stainless, cast iron, aluminum, copper, red brass, lead, monel, and inconel with 383 chemicals. Tables show wall thicknesses, weights, burst pressures, recommended working pressures on pipe ¼ to 6 in. diameter. *A. M. Byers Co., Dept. HPAC, Clark Bldg., Pittsburgh* 22.

▶ *PIPE* — Polyvinyl chloride pipe described in new 40 page booklet 24. Chemical resistance charts included together with suggested applications. Rigidity, lightness, simplicity of installation, smoothness of internal surface among features cited by manufacturer. *National Tube Div., United States Steel Corp., Dept. HPAC,* 525 *William Penn Pl., Pittsburgh* 30.

▶ *PIPE INSULATION* — New 4 page booklet highlights "Gilsulate" pipe insulation. Details, illustrations describe "Gilsonite," a hydrocarbon mineral from which insulation is blended. Available for temperatures to 520 F. *American Gilsonite Co., Dept. HPAC,* 134 *W. Broadway, Salt Lake City.*

▶ *PIPE JOINING* — Illustrated 2 page bulletin describes "Vic-Easy" method of joining thin wall steel, aluminum pipe and tubing. System provides positive, leak tight connections by means of quick couplings assembled on grooves precision rolled in ends of tubing, company says. Three different couplings discussed. *Victaulic Co. of America, Dept. HPAC, Box* 509, *Elizabeth, N. J.*

Accident Insurance Just One Low-Cost Premium For Life— A Babbitt SPROCKET RIM



Babbitt

Adjustable
SPROCKET RIM
with Chain Guide

- Simplifies pipe layout
- Fits any size valve wheel
- Easy to install and operate
- Operates any valve from plant floor
- Time and money saving fixture
- No maintenance, first cost only cost
- Packed, completely assembled, one to a carton
- Hot galvanized, rust-proof chain available for all sizes
- Easy to follow instructions with each unit
- Your supplier carries complete stocks
- Write for new descriptive catalog sheet and prices

Babbitt STEAM SPECIALTY CO.

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MANNING & LEWIS ENGINEERING CO.
28-42 OGDEN ST. NEWARK 4, N.J.
WORKING PRESS:- SHELL TUBES
UNIT NO. JOB NO.

FUEL OIL HEATERS WATER HEATERS and COOLERS

M & L TANK OUTLET HEATERS
With Bolting Flange

FUNCTION: Installed in bulk storage tanks to prewarm viscous liquids (fuel oil, tar, road oil, molasses, lubricating oil or asphalt) that have been exposed to low temperatures.

CONSTRUCTION: Heads available in either cast iron or steel. Tubes of heavy gauge steel. Tube sheets and baffles of steel.

HEATING MEDIUM: Steam or hot water.

SPECIAL FEATURES: Economical to operate . . . only the liquid that is being withdrawn is heated. Special baffling assures greater efficiency. Can be bolted directly to nozzle. Special swing valve, as optional equipment, permits closing off the shell of suction heaters to enable removal of heads without emptying tank. (not illustrated).

For further details send for your copy of Bulletin #743.

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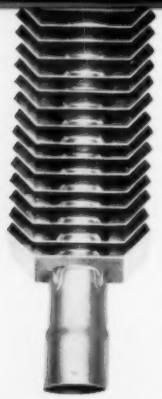
Heat Exchangers
Condensate Coolers
Heating Elements
Converters
Tank Heaters
Tankless Water Heaters
Instantaneous Water Heaters

Manning & Lewis Engineering Company
DESIGNERS & MANUFACTURERS OF QUALITY HEAT EXCHANGE EQUIPMENT
28-42 OGDEN STREET NEWARK 4, NEW JERSEY

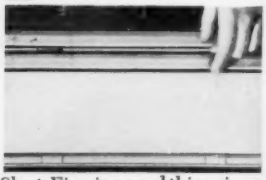


Per square inch – feature for feature – Slant-Fin out-engineers, out-performs all other competitive heating units—costs you less to install. *Here's why:*

Slant-Fin is designed for quick and easy installation. Time-saving piano hinges on end caps, wall trim, inside corners let you snap on every accessory without screws or tools – fast! *No cutting:* 4', 5', 6', and 8' lengths with telescoping extensions fit any job. And the patented slanted fins have no sharp edges to cut fingers.

Because of its revolutionary construction Slant-Fin has 29% *more* heating surface, provides increased air circulation because of flue action. Rigid tooth-and-bubble flanges lock fins together, create an element so strong you can actually stand on it. Fin-touch-fin construction soaks up sound, eliminates "ping" and "pong" noises.

Once a Slant-Fin unit has been installed, it will continue to operate at peak efficiency, *without* call-backs.



Slant-Fin pioneered this unique vane damper that pivots on stainless steel rivets, opens, closes, sets at any position with the flick of a finger.

Want to know more about Slant-Fin features that make your job easier? Write for our free booklet, "A NEW SLANT ON CUTTING BASEBOARD HEATING COSTS."

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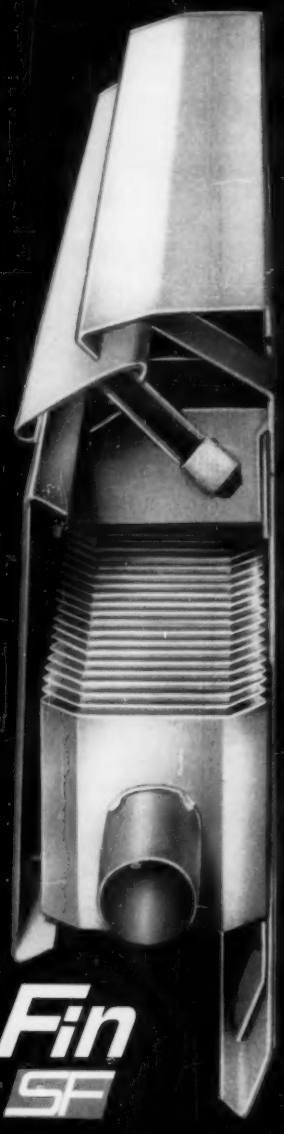
RADIATOR CORP.
87-49B 130 St., Richmond Hill, N. Y.

THE BEST BASEBOARD HEATING ANYONE CAN BUY!



RECENT TRADE LITERATURE *Continued*

▸ *POLYETHYLENE* — Case histories of the use of "Argo-170" polyethylene presented in 19 page catalog. Mechanical, thermal, electrical properties given in tabulated form. Short history of the development of various materials used to combat industrial corrosion problems included. Materials generally used for handling corrosive fluids, solids described. *Argo Plastic Products Co., Dept. HPAC,* 1095 *Brookpark Rd., Cleveland* 9.

▸ *POWER BELTS* — New 12 page booklet describes power transmission belts made of polymer and chrome tanned leather. Applications, bearing load reduction, tensioning, maintenance covered. Illustrations, selection charts included. *Extremultus, Inc., Dept. HPAC,* 405 *Lexington Ave., New York* 17.

▸ *REGULATOR VALVES* — New 4 page brochure J-SC describes how sliding gate regulator valves may be sized. Methods given to adjust sizing for variations in pressure, temperature, viscosity, specific gravity. Charts cover steam, liquid, gas service. *Jordan Corp., Dept. HPAC,* 6013 *Wiehe Rd., Cincinnati* 13.

▸ *SHEET PACKINGS* — New 8 page booklet P-328 covers specification, engineering, application testing data on industrial sheet packings. Nineteen varieties of packings described are fabricated from asbestos, rubber, synthetic rubber, neoprene, silicone, fiber, teflon. All can be supplied in gasket form in any shape or size, standard or special. Application information included. *Crane Packing Co., Dept. HPAC,* 6400 *Oakton St., Morton Grove, Ill.*

▸ *SPEED REDUCERS* — More than 160 standard styles of double reduction speed reducers in ratios 75:1 to 4900:1 covered in new 20 page catalog CD-230. Worm over, worm under, gear shaft vertical models with torque ratings to 618,000 in. lb discussed. Features cited by company: double enveloping worm gearing, oversize taper roller bearings, ribbed housings. *Cone-Drive Gears, Div. Michigan Tool Co., Dept. HPAC,* 7171 *E. McNichols Rd., Detroit* 12.

▸ *STEAM HEATING COILS* — New 8 page booklet B-1418 describes "Type D-1" double tube steam distributing coils. Features of new units, physical data given. Tables on final air temperature, temperature rise correction factors provided. *American Standard, American Blower Div., Dept. HPAC, Detroit* 32.

RECENT TRADE LITERATURE *Continued*

▸ *SUN REFLECTING CANOPIES* — Aluminum alloy canopies designed for stores, office buildings, factories, schools, institutions described in new 4 page bulletin. Units can be mounted at any angle through arc of 90 deg, company says. Available in roll up, stationary types in variety of sizes. Features highlighted by manufacturer: modern styling, full ventilation, durability. *Hunter Douglas Aluminum Div. of Bridgeport Brass Co., Dept. HPAC, 405 Lexington Ave., New York 17.*

▸ *THERMOCOUPLES* — New chart has color codes, calibration symbols for thermocouples, thermocouple extension wires, pyrometer wire resistance figures. All thermocouple, extension wire calibrations listed with corresponding ISA calibration symbols. Resistance figures given for solid conductors 1 to 40 gage; for stranded conductors 14 to 28 gage. *Thermo Electric Co., Inc., Dept. HPAC, Saddle Brook, N. J.*

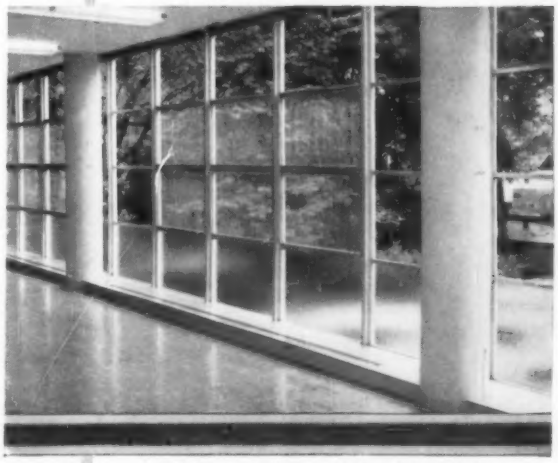
▸ *THERMOSTAT* — Bulletin THSN-1A offers revised data on fixed temperature, hermetically sealed thermostat. Model designed for use in high limit heater controls, refrigeration equipment, motor winding overheat protection systems. Configurations, dimensions included. *Metals & Controls Corp., Spencer Thermostat Div., Dept. HPAC, Attleboro, Mass.*

▸ *TIME CONTROLS* — New booklet 856-A covers time switches for use in building and plant heating. Specifications of each unit, wiring diagrams included. Ten illustrations provided. *Tork Time Controls, Inc., Heating Div., Dept. HPAC, Mount Vernon, N. Y.*

▸ *UNIT VENTILATORS* — Bulletin 600-E-3A describes various colors of school unit ventilators, cabinets. New shades identified as Sahara tan, platinum green, autumn brown, colonial blue, mist gray, tropic green, coral tan. Five color samples of formica laminated plastic for top surfaces shown. *American Air Filter Co., Dept. HPAC, 215 Central Ave., Louisville.*

▸ *UNIT VENTILATOR CONTROLS* — New performance test report describes unit ventilator controls used at a selected installation. Combination of precision control valve and dual element compensated temperature controller maintains room, discharge temperature within comfortable limits, company says. Illustrations, charts included. *Barber-Coleman Co., Dept. HPAC, 1300 Rock St., Rockford, Ill.*

Blend It...
Hide It...
Combine It...



Installed as a continuous strip in window head or sill (as above), AGITAIR STRIPLINE is the only practical means for air curtaining plate glass windows or wall areas to counteract summer heat or winter chill.

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STRIPLINE
DIFFUSERS

BLEND IT . . . specify AGITAIR STRIPLINE as a continuous decorative unit, or in sections to meet any requirements of interior treatment.

HIDE IT . . . in shallow lighting coves for perfect concealment.

COMBINE IT . . . with unit or continuous lighting fixtures.

AND REMEMBER . . . no matter how you use it — AGITAIR STRIPLINE diffusing vanes create maximum mixing and aspiration . . . quick temperature equalization . . . and correct air distribution over any desired length.

Every Inch a Diffuser . . . the Vanes Make the Difference

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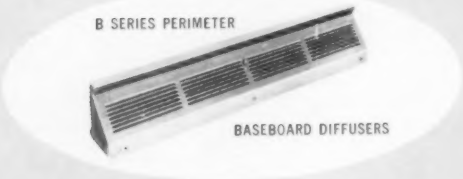

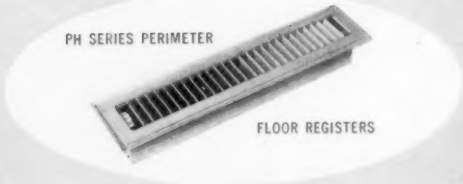

for two-way heating-air conditioning systems!

For every size and shape of conditioned space, there's a Standard Register engineered to turn warm or cool air into draft-free comfort, without blasts, hot spots, or cold corners.

Mail coupon now for new free catalog!

MEMBER INDOOR COMFORT

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Please send your new Registers & Grilles catalog.

Name_____
Firm_____
Address_____
City_____ Zone____ State_____

PUT A WARM AIR REGISTER UNDER EVERY WINDOW

RECENT TRADE LITERATURE — *Continued*

▸ *VALVES* — New 4 page bulletin W-14 describes emergency cut-in valves. Units automatically open to emergency water supplies when normal water supply is interrupted, either from outage of electrical power or mechanical failure causing pump shutdown, company says. Technical data included. *Golden-Anderson Valve Specialty Co., Dept. HPAC, 1210 Ridge Ave., Pittsburgh 33.*

▸ *VALVE CONTROLS* — New 6 page booklet 4-57 describes valve controls designed to assure tight valve seat. For use in parallel or series within fixed limits with springs that provide desired compensation, company says. Controls available in weatherproof and explosionproof construction, may be field mounted on any size valve in various positions. *Philadelphia Gear Works, Inc., Dept. HPAC, Erie Ave. & G St., Philadelphia 34.*

▸ *WELDING EQUIPMENT* — New 20 page catalog ADG-2057-C describes publications, audio visual aides pertaining to welding equipment. Publications discussed cover applications of industrial gases; welding, cutting techniques and equipment. Motion pictures listed depict automatic welding, machine gas cutting. *Air Reduction Sales Co., Div. of Air Reduction Co., Inc., Dept. HPAC, 150 E. 42nd St., New York 17.*

▸ *WELDING EQUIPMENT* — New 180 page 1958 edition of pocket sized *Welding Data* book, TIS 2575A, features welding procedures for base metals. Fabrication, maintenance repair, salvage, special welding applications covered. Data given on methods of gouging, chamfering, removing unwanted metal without special equipment. *Eutectic Welding Alloys Corp., Dept. HPAC, Flushing 58, N. Y.*

▸ *WELDING EQUIPMENT* — New 60 page catalog, *How to Get Better Welds*, contains information on metals and electrodes, joints, typical welding positions, welding symbols, standard steel shapes available for welding. Definitions of welding terms, weights of weld metal deposits, spark tests by grinding, types of electrodes also discussed. *Hobart Bros. Co., Dept. HPAC, Troy, Ohio.*

▸ *WELDING FITTINGS* — New 8 page booklet FB-503 explains methods of purchasing welding fittings and flanges. Among factors to consider are quantity, pipe size information, weight designation, description, bevels, company says. *Babcock & Wilcox Co., Tubular Products Div., Dept. HPAC, Milwaukee 48.* ‡

WHO'S WHAT . . .

(New personnel, promotions)

▸ *ALLIS-CHALMERS MFG. CO.* — Three vice presidents are P. F. Bauer, E. J. Mercer, William M. Wallace. A. D. Dennis, secretary, succeeds W. E. Hawkinson who has retired following 50 years of service.

▸ *BRISTOL BRASS CORP.*—Roger E. Gay, former president and chairman of the board, awarded the Howard Coonley medal by American Standards Association for "great service in advancing the national economy through voluntary standards."

▸ *PEERLESS PUMP DIV., FOOD MACHINERY AND CHEMICAL CORP.* — John F. Van Dam, Los Angeles works manager. Floyd W. Widener, present Los Angeles factory manager, delegated added responsibility of serving in advisory capacity to division management on matters of production.

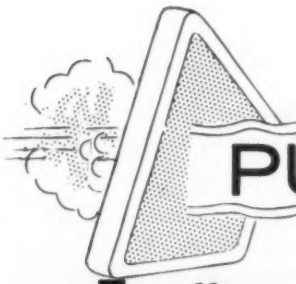
▸ *BABCOCK & WILCOX CO., TUBULAR PRODUCTS DIV.*—Four metallurgist supervisors are: John F. Beck, technical service; Clark P. Church, process development; Dr. John F. Ewing, research; Thomas M. Krebs, customer service.

▸ *MECHANICAL CONTRACTORS ASSOCIATION* and *SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION* — Representatives at National Joint Cooperative Committee of Associated General Contractors of America, Inc. and Council of Mechanical Specialty Contracting of America, Inc. were Joseph H. Spitzley, Detroit. MCA president: Lloyd B. Gruman, Jr., New York. MCA executive secretary; Nat N. Leas, Fresno, Calif., SMACCNA president: Joseph Wilder, Elgin, Ill., SMACCNA executive secretary.

▸ *JOHNS-MANVILLE CORP.* — Adrain R. Fisher, chief executive officer and chairman of the board; Clinton B. Burnett, executive vice president and a director.

▸ *INDUSTRIAL ACOUSTICS CO., INC.* — Charles N. Rink, head of new department which will handle products applicable to air conditioning field.

▸ *FEDDERS-QUIGAN CORP.*—Salvatore Giordano, president and chairman of the board, named chairman of the air conditioning and refrigeration division of Muscular Dystrophy Associations of America, Inc. Mr. Giordano has also been named "Man of the Year" by the Columbian Civic Club, Newark, N. J.



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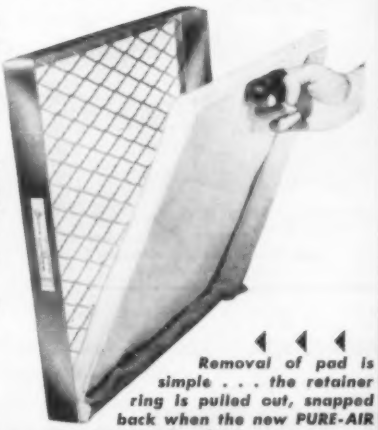

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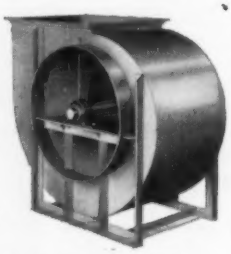
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WHO'S WHAT

Continued

▸ *TYPHOON AIR CONDITIONING CO., INC., DIV. OF HUPP CORP.* — John A. Gilbreath, vice president sales.

▸ *AMERICAN RADIATOR AND STANDARD SANITARY CORP.* — J. A. Hickman, government relations director; Joseph J. Cambal, Great Lakes sales district manager.

▸ *ROCKWELL MFG. CO.* — Weldon D. Willes, general manager, and Fred J. Langtry, works manager, of new 180,000 sq ft valve plant in Kearney, Neb. Five assistant product managers are: Thomas I. Stacy, transmission line sales; Richard E. Miller, lubricants and accessories; Jack W. Harris, refinery and chemical sales; John R. Applegate, utilities sales; Clyde H. Chronister, production sales.

▸ *UTILITY FAN CORP., DIV. OF UTILITY APPLIANCE CORP.* — Marcus McGuire, head of midwest and eastern market with headquarters in Park Forest, Ill.

▸ *BUFFALO FORGE CO.* — J. Barrie Grahm, director of research; Richard D. Madison, consulting engineer.

▸ *JOY MFG. CO.* — William L. Wearly, president; A. B. Drastrup, executive vice president.

▸ *E. I. DU PONT DE NEMOURS & CO., INC.*— A. Hicks Lawrence, Jr., manager of "Aerosol" propellent sales; Thomas D. Johnson, Jr., assistant director of sales; James C. Feldmann, manager of specialty products sales. All three are in the "Freon" products division.

▸ *DUNHAM-BUSH, INC.*—Argo L. Mattison, application engineer.

▸ *AMERICAN STANDARD, PLUMBING AND HEATING DIV.* — Three managers in sales department are John E. Huey, George A. Beise, Robert W. Clapperton.

▸ *YORK CORP.*—M. S. Lebair, assistant vice president of marketing. Three general sales managers are: Walter L. Pharo, contract products; Robert G. Werden, engineered equipment; Robert E. Cassatt, packaged products.

WHO'S WHAT

Continued

▸ *CARRIER CORP.* — Dr. J. F. Downie Smith, vice president, to head central research and development division. Walter A. Grant, vice president since 1953, coordinator of all development engineering activities. Ernest C. Hungate, industrial air conditioning product specialist for machinery and systems division.

▸ *BARNES MFG. CO.*—M. H. Pryor, chairman of the board of directors; Fred B. Hout succeeds Mr. Pryor as president of the firm. John A. Mintz, director and treasurer, appointed president of Barnes Holding Co., a unit of the Barnes group of manufacturing plants.

▸ *IRON FIREMAN MFG. CO.*—George Senseney, director of engineering at the firm's electronics and heating controls plant.

▸ *WAUKESHA MOTOR CO.*—New officers named are: Charles E. Nelson, Jr., executive vice president; J. Grant Swain, vice president of sales; Newton H. Willis, vice president of engineering; Lewis W. Youker, secretary and treasurer; Joseph J. Kleinbrook, assistant secretary and assistant treasurer.

▸ *SQUARE D CO.*—Lawrence G. Maechtlen, first vice president.

▸ *CULLIGAN, INC.*—J. William Moffett, director of technical service.

▸ *A. M. BYERS CO.* — A. S. Chalfant, director of steel sales; James M. Carman, staff assistant to Mr. Chalfant.

▸ *AIRTEMP DIV., CHRYSLER CORP.*— Leonard M. Call, merchandising manager. He will direct all advertising and sales promotion activities pertaining to commercial cooling equipment and room air conditioners.

▸ *BRYANT MFG. CO.*—Will J. Chappell, general product sales manager.

▸ *HOWELL ELECTRIC MOTORS CO.*—Roger N. Burgess, manager of field sales; H. D. Lewis, Detroit district manager.

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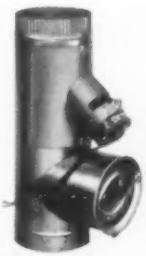

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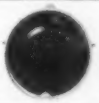

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WHO'S WHAT

Continued

▸ *KEASBEY & MATTISON CO.*—Ralph L. Lanz, planning and inventory department manager; Gerald F. Connell, service to sales supervisor; Robert M. Russell, supervisor of production and planning.

▸ *RUSSELL, BURDSALL & WARD BOLT AND NUT CO.*—John J. Lohrman, manager of distribution.

▸ *EMERSON ELECTRIC MFG. CO.*—Richard B. Loynd, merchandise sales manager.

▸ *HUCK MFG. CO.*—Charles M. Albritton, vice president in charge of manufacturing.

▸ *DRAYER-HANSON, DIV. OF NATIONAL-U. S. RADIATOR CORP.*—C. W. Pollock, manager air conditioning and refrigeration division; A. J. Mallinckrodt, chief development engineer; Sam Nelson, manager industrial division.

▸ *INTERNATIONAL NICKEL CO., INC.*—Robert E. Savage, head of distributor sales section of nickel department. He succeeds the late E. J. Bothwell.

▸ *ANSUL CHEMICAL CO.* — Clifford C. VanderWall, vice president in charge of manufacturing.

▸ *PENNSALT CHEMICALS CORP.* — W. Cooper Willits, treasurer.

▸ *AMERICAN METAL HOSE DIV., AMERICAN BRASS CO.* — William B. Hammond, sales manager.

▸ *RUUD MFG. CO.* — John P. Ewing, manager of manufacturing.

▸ *PULLMAN VACUUM CLEANER CORP.*—Saul A. Fern, advertising manager.

▸ *L. O. F. GLASS FIBERS CO.*—Clinton F. Hegg, elected to the board of directors. He is vice president and general sales manager.

▸ *CORY CORP.* — Robert Dyas, contract sales manager for air conditioning.

▸ *PITTSBURGH COKE & CHEMICAL CO.*—John H. Caldwell, assistant sales manager, protective coatings division.

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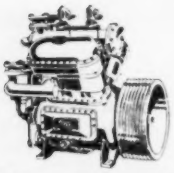

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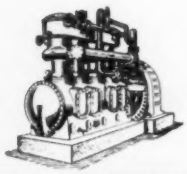

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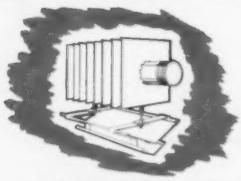

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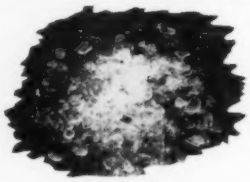

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▸ *COMBUSTION ENGINEERING, INC.* — H. G. Ebdon, executive vice president, elected president and director to succeed Martens H. Isenberg who has resigned because of ill health. Arthur J. Santry, Jr., vice president and director, named vice chairman.

▸ *BUENSOD-STACEY, INC.* — William H. Severage, manager of piping department.

▸ *AMERICAN STEEL BAND CO.*—Raphael J. Larko, product manager of ventilators.

▸ *PECK, STOW & WILCOX CO.*—Roland J. Ahern, president of the firm, elected president of the Service Tool Institute for 1958.

▸ *PENN CONTROLS, INC.*—H. M. Carnahan, director of sales.

▸ *McQUAY, INC.*—Dean C. Seitz, refrigeration sales manager; R. D. Kemper, sales manager of the coil department.

▸ *W-K-M MFG. CO., DIV. OF ACF INDUSTRIES, INC.* — Glenlyn H. Blackburn, foundry manager.

▸ *CRANE CO.* — Two vice presidents are Maurice Nelles, engineering, and Paul S. Kempf, personnel and industrial relations.

▸ *AMERICAN AIR FILTER CO., INC.* — John M. Kane, manager of dust control products, elected president of the board of directors of the Occupational Health Institute of Kentucky. Aim of the organization is to advance health practices in Kentucky industry.

▸ *FOLLANSBEE ENGINEERING & SUPPLY*—E. Lee Merrill, general manager.

▸ *WORTHINGTON CORP.* — F. E. Dunn elected president of the Vertical Turbine Pump Association for 1958.

▸ *NATIONAL-U. S. RADIATOR CORP.* — H. Wells Williams, consultant for engineering and research department; E. S. Spangler, manager of heating elements engineering.

WHO'S WHAT

Continued

▸ *GREEN FUEL ECONOMIZER CO.* — Allan Davies, board chairman; Bernard de Turenne, president and treasurer; Gert V. Eiserman, vice president in charge of sales; Russell H. Kraft, vice president in charge of engineering; Donald S. Gordon, vice president of contract division.

▸ *NATIONAL TUBE DIV., UNITED STATES STEEL CORP.*—Robert L. Swank, manager of sales-plastic pipe; Thomas D. Cramer, assistant to Mr. Swank; Robert K. Henderson, district sales manager in Philadelphia.

▸ *CHESFLEX CORP.* — Harold M. Belmuth, sales manager.

▸ *OLIN MATHIESON CHEMICAL CORP.*—George A. Waterman, director of product sales and engineering; Elmer M. Richardson, director of marketing for "Olin Aluminum."

▸ *DAYTON RUBBER CO.*—A. L. Freedlander named Knight of the Royal Order of St. Olaf—the highest honor the country of Norway may bestow upon a civilian.

▸ *KURZ & ROOT CO.*—Henry Kuhn, quality control manager.

▸ *GIBSON REFRIGERATOR CO., DIV. OF HUPP CORP.*—Louis W. Hamper, Jr., assistant to the vice president in charge of sales.

▸ *FLEXIBLE TUBING CORP.*—Charles Kenneth French, manager product development department at Anaheim, Calif., plant.

▸ *HOOKER ELECTROCHEMICAL CO.*—Dr. Clarence A. Stiegman, technical director; Dr. J. Howard Brown, general manager.

▸ *FAIRBANKS, MORSE & CO.* — Edward E. Lynn, director of personnel.

▸ *ELECTRIC FURNACE-MAN, INC.*—George Hewitt, vice president in charge of sales and member of the board of directors.

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WHO'S WHAT

Continued

▸ *ARMSTRONG CORK CO.* — William T. Wade, assistant treasurer; Joseph H. Pittenger, manager of organization and methods department.

▸ *JOSEPH T. RYERSON & SON, INC.*—Joseph D. Gavin, manager of sheet and strip sales at Chicago plant; Joseph E. Praser, general superintendent of the Cleveland steel service plant.

▸ *BITUMINOUS COAL RESEARCH, INC.* — Maurice Deul, geologist, named to chemical and mineralogical research, economic geology laboratory assignment; Robert L. Sankey, publications manager.

▸ *NATIONAL BUREAU OF STANDARDS* — J. J. Drapeau, mechanical engineer, air conditioning, heating, and refrigeration section of building technology division.

IN THE TERRITORIES . . .

(Recent sales appointments)

▸ *FLORI PIPE CO.*—New district sales managers are: Herman C. Heink, St. Louis, to serve western Pennsylvania, Virginia, West Virginia, North Carolina, Kentucky, Tennessee, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, Ohio, northern Arkansas, Michigan, western New York, Washington D. C.; William E. Keim, New York, to serve Maine, New Hampshire, Vermont, Massachusetts, New Jersey, Maryland, eastern New York, eastern Pennsylvania, Rhode Island, Delaware; D. W. Jacobus, Tulsa, to serve Nebraska, Kansas, Colorado, Oklahoma, northern Texas; Kenneth E. Martin, Los Angeles, to serve Washington, Oregon, California, Nevada, Utah, Arizona; J. B. Spurlock, Houston, to serve New Mexico, Texas, Louisiana, South Carolina, Mississippi, southern Arkansas, Alabama, Georgia, Florida.

▸ *NATIONAL-U.S. RADIATOR CORP.*—Alfred R. Scarperi, appointed to head sales engineering work on air conditioning in St. Louis. J. M. Newlon, Jr., manager of Atlanta, Ga., branch office.

▸ *AMERICAN-STANDARD, PLUMBING AND HEATING DIV.*—Robert G. Holmes, operations manager in Allegheny sales district; John W. Wallace, Jr., Salt Lake City sales manager.

WHO'S WHAT

Continued

▸ *DEAN THERMO-PANEL COIL DIV., DEAN PRODUCTS, INC.*—Twenty five new representatives are: Associated Engineers, Birmingham, Ala.; A. A. Betts Co., Cincinnati; Colby Equipment Co., Indianapolis; R. J. Denton Co., Syracuse, N. Y.; H. F. Eastman Co., Inc., Needham, Mass.; Edward H. Elliott, Philadelphia; Forsyth-Constant Co., Portland, Oreg.; Horblit & Co., Denver; Alfred Kent & Son, Houston; Roger P. Kipp, St. Louis; Louisiana Steam Equipment Co., New Orleans; George R. Mellema Co., Minneapolis; Montanye Engineering Sales, Salt Lake City; William E. Neumeister, Buffalo; Bernard Packtor Co., New Haven, Conn.; Steve Palmer & Co., Atlanta, Ga.; Joseph L. Paradis, Greensboro, N. C.; Charles C. Plummer, Washington, D. C.; Smith Monroe Co., South Bend, Ind.; W. Scott Turner, Arcadia, Calif.; W. M. Wilson Co., Berea, Ohio; Johnson Roney & Assoc., Inc., Clearwater, Fla.; Avery M. Walsh & Sons, Albany, N. Y.; Kent Engineering Co., Montreal, Canada; T. J. McCarthy Ltd., Ontario, Canada.

▸ *COPELAND REFRIGERATION CORP.*—W. H. Kiefaber Co., representative for Dayton, Ohio, area. Louis A. Wallace, field representative for Texas, Oklahoma. John Young, district sales representative for Kansas, Missouri, southern Illinois. Donald R. Macklem, district sales representative for Nebraska, Iowa, northern Illinois, southern Wisconsin.

▸ *LENNOX INDUSTRIES, INC.*—Ten representatives are: Cryer & Wolfe, eastern Pennsylvania and southern New Jersey; J. C. Rehard & Assoc., Detroit; H. F. Robinson, Massachusetts; George C. Cummings, eastern New York and northern New Jersey; A. J. Allen & Co., Indiana and sections of Illinois, Kentucky; Aircon Sales Co., Nashville, Tenn.; T. R. Christy Co., Wisconsin; H. C. Sharp Co., southern Illinois and sections of Missouri; Edward Filkins, northern Illinois; Manufacturers Sales Co., Kansas City.

▸ *DRAVO CORP.*—Empire Heating and Cooling Co. and Hank Thurstin Co., distributors of "Dravo" heating equipment for 30 Montana, 10 Wyoming counties and for Colorado, parts of Wyoming, New Mexico, respectively.

▸ *OLIN MATHIESON CHEMICAL CORP.*—Lafayette Steel & Aluminum Corp., distributor for "Olin Aluminum" in Illinois, Indiana, Wisconsin, Iowa, western Michigan, western Ohio, northern Kentucky, Missouri, Minnesota territory.

SAVE 2 WAYS WITH FURNAS "In Between" STARTER SIZES

LOWER COST—save up to 25% by buying the exact size starter for the job, instead of having to take a standard one that may be too large.

LESS SPACE—save up to 40% by selecting a compact starter of a size designed to fit your requirement.

Furnas offers you 10 Magnetic Starter sizes instead of the usual five—5 standard and 5 "in-between" sizes. The "in-between" sizes allow you to choose the control that is exactly suited for your particular job when a standard size is not quite right. No need to waste money or space on a starter that is too large.

For information on our complete line of air conditioning and refrigeration controls, write for Bulletin 5519. Furnas Electric Company, 1041 McKee Street, Batavia, Ill.

A31

FURNAS

25TH YEAR

FURNAS ELECTRIC COMPANY

BATAVIA, ILLINOIS

SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

WHO'S WHAT

Continued

▸ *WHEELABRATOR CORP.*—Donald W. Miller, sales engineer in Detroit sales office; Fred H. Smith, sales engineer in Detroit territory; Wayne W. Clements and Andrew Joye, sales and service engineers in Detroit territory.

▸ *POWERS REGULATOR CO.*—Branch managers of three new offices are: J. G. Slattery, Columbia, S. C.; Robert Tustison, Green Bay, Wis.; Del Schroeder, Davenport, Ia.

▸ *MARSH INSTRUMENT CO.*—Don L. Warner, sales representative for Philadelphia area. He will serve eastern Pennsylvania, New Jersey, Washington, D. C., Maryland, Delaware.

▸ *DEMING CO.*—Glen R. Everett and Kenneth M. Spear, sales representatives for northeastern Ohio, western Pennsylvania and for southern Florida, respectively.

▸ *DRAYER-HANSON, DIV. OF NATIONAL-U. S. RADIATOR CORP.*—Don R. Groth, representative in Oklahoma.

▸ *WESTINGHOUSE ELECTRIC CORP., STURTEVANT DIV.*—A-C Supply Co. of Philadelphia, distributor of industrial fans, ventilating sets, and steam, hot water, gas fired unit heaters.

▸ *AUTOMATIC SWITCH CO.*—Ackerman Chacco Co., Inc., distributor of "Asco" solenoid valves in Cincinnati area.

▸ *SPENCER THERMOSTAT DIV., METALS & CONTROLS CORP.*—W. E. Hobson, Jr., field engineer in Alabama, Florida, Georgia, Mississippi area.

▸ *AMANA REFRIGERATION, INC.*—J. A. Fahey, regional sales manager for Cleveland area.

▸ *TRANE CO.*—George W. Robbins, manager of new Fargo, N. D., sales office; Ted M. Stephens, sales engineer at San Antonio, Tex.

▸ *ALLIS-CHALMERS MFG. CO.*—Hannon Electric Co., distributor in Summit, Portage, Stark, Tuscarawas counties in Ohio.

▸ *L. J. WING MFG. CO.*—Two sales representatives are Stromquist & Co., Atlanta, Ga., and Central Station Equipment Co., Tucson, Ariz.

FASTEN METALS FASTER

WIDE RANGE OF TONGS SUIT MILLER PORTABLES FOR EVERY SHEET METAL APPLICATION

Miller portables require no pampering, stand up to the job for years on end. Light weight, plus "probe" design, produces high volume of low-fatigue work. Natural position handle threads into either side of welder, lever locks tongs firmly to work. Model MSW in either 110v or 220v, weighs 23 lbs., welds 1/8" mild or stainless steel, or two 20 ga. galvanized sheets; model LMSW, 220v, weighs 31 lbs., welds to 3/16" of mild or stainless, or two 16 ga. galvanized pieces. Timers available for both models.

miller ELECTRIC MANUFACTURING COMPANY, INC.
Appleton, Wisconsin

Distributed in Canada by Canadian Liquid Air Co. Ltd., Montreal, P. Q.

WHO'S WHAT

Continued

▸ *YOUNG RADIATOR CO.*—Frank E. McInnis, eastern district sales supervisor in heating, cooling, air conditioning division.

▸ *GENERAL AUTOMATIC PRODUCTS CORP.*—Carl Klotzbach, district sales representative for eastern Pennsylvania.

▸ *MARATHON ELECTRIC MFG. CORP.*—Ruby P. Salzman, western central regional sales manager.

▸ *BALDOR ELECTRIC CO.*—George Tuoschard, district sales manager for Dayton, Ohio, area.

▸ *ARMSTRONG CORK CO.*—Claude E. Foster, branch manager in Houston.

▸ *SQUARE D CO.*—Daniel H. Miller, manager of western division with headquarters in Los Angeles.

▸ *THOR POWER TOOL CO.*—Alfred W. Escoffier, manager of Seattle branch.

▸ *TEMCO, INC.*—Robert H. Ewing, mid-Atlantic regional sales manager.

▸ *TUTHILL PUMP CO.*—Hydraquip Corp., sales representative in Texas, Gulf Coast territory.

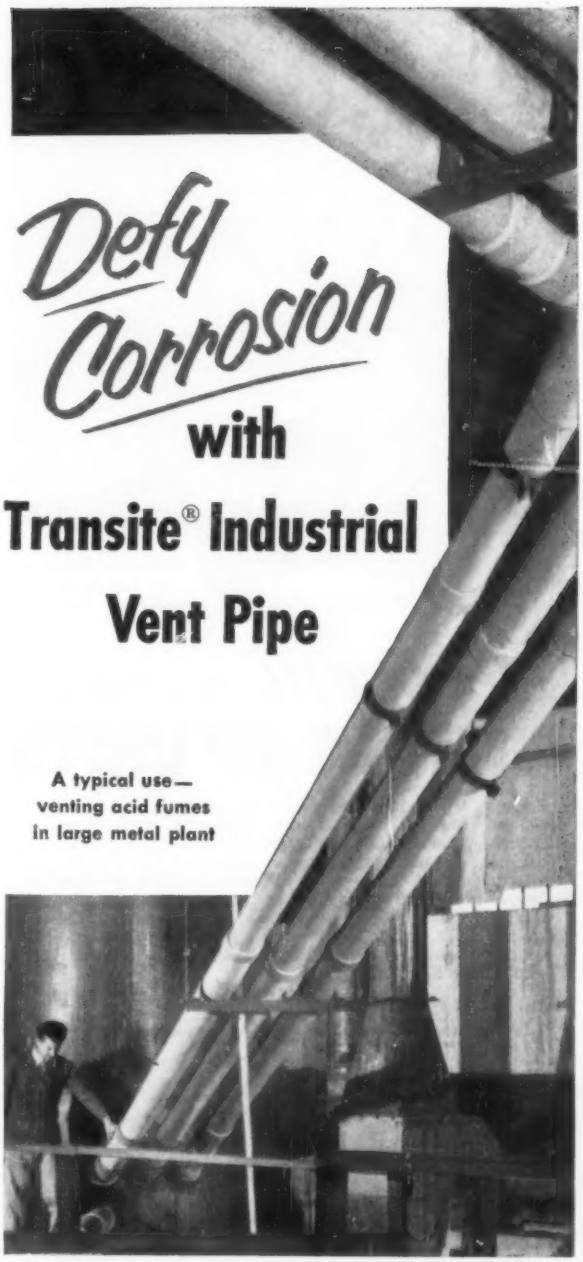
▸ *CARRIER CORP.*—Arco Engineering Co., sales representative in Louisville area.

▸ *RUBEROID CO.*—Philip E. Patrick, assistant sales manager, Millis, Mass., district.

▸ *RECOLD CORP.*—Frank C. Hawk, representative for New York, New Jersey, Pennsylvania, New England states.

▸ *NUKEM PRODUCTS CORP.*—George W. Akers Co., representative for Michigan.

▸ *PENNSALT CHEMICALS CORP.*—Pacific Scientific Co., representative for Washington, Oregon, Idaho, Montana, California, Nevada, Arizona territory. ‡



IN SEVERE VENTING SERVICES, Transite's outstanding performance is a matter of record. Made of asbestos and cement, two of nature's most indestructible materials, it resists the attack of most fumes, vapors, and dusts.

Installed indoors or out, Transite Industrial Vent Pipe can't rust or rot, never needs paint, nor other protective coating. Wide variety of fittings makes it adaptable to any layout. For more information, write Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.

Johns-Manville

TRANSITE INDUSTRIAL VENT PIPE

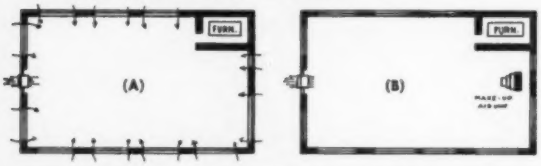
An Asbestos-Cement Product

Aerovent INDUSTRIAL

AIR MAKE-UP UNITS

Performance of fans and ventilating equipment installed to exhaust from production and processing areas depends *entirely* upon the availability of ENOUGH AIR! Without sufficient quantities to replace air exhausted, the air-handling system is soon "starved," creating a negative pressure or "vacuum" condition which is responsible for infiltration of outside air around doors and windows. The effect of the resulting draft places an additional work load on the plant heating system, with an ultimate decline in temperatures throughout the working area.

here's a typical "MU" installation



Warm air, exhausted from a machine shop area, replaced by cold air pulled through cracks and door openings (A). Filtered and tempered air, supplied by Air Make-Up Unit installed in same area (B) helps to maintain constant temperatures; levels-off "peaks" and "valleys" in boiler or furnace loading.

New Aerovent Industrial Air "Make-Up" Units, designed to supply ample quantities of clean, pre-heated air, aid in maintaining peak fan performance, reducing drafts and in stabilizing uniform heating loads. Available in seven unit arrangements in sizes 24" to 54" for capacities to 33,000 CFM. Write for free Bulletin 850.

All Aerovent Fans are rated in accordance with the Standard Test Code and U.S.D.C. Comm. Std. CS178-51

Aerovent FANS *Aerovent* FAN COMPANY, INC.

Ash and Branch Sts. • Piqua, Ohio

WE HEAR THAT . . .

▸ One of the country's largest and most highly automated copper tube mills is now in operation at the Cleveland plant of *CHASE BRASS & COPPER CO.* Copper tubing—from billet to finished tube—is produced on electronically controlled, high speed machines. Among other equipment at the mill is a 400 ft long draw bench capable of simultaneously drawing five tubes from an initial length of 43 ft to straight lengths of 210 ft. A new magnetic defect detector performs critical internal and external inspections by automatically marking and rejecting faulty tube. Continuous production of nonwelded lengths of copper tubing to 9000 ft long at greater speed has been attained in the plant.

The company has also announced the opening of a new one story, 62,000 sq ft warehouse and district sales office in San Francisco. The installation will serve the industrial South San Francisco and San Bruno area.

▸ *HAMMEL-DAHL CO.* will be operated as a major division of *GENERAL CONTROLS CO.* beginning January 2, 1958. The acquisition will enable General Controls to extend its industrial valve line into the field of high pressure and temperature applications for refining and for atomic energy and chemical processing, according to *WILLIAM A. RAY*, General Controls president. Management of Hammel-Dahl will continue under existing executive and managerial officials with *EDWARD T. DAHL* as president of the division and *THOMAS PONTON* as general manager.

▸ A modern, custom built showroom featuring new developments in hydronic air conditioning was opened recently in Chicago by the *PLUMBING AND HEATING DIV., AMERICAN-STANDARD.* The 4500 sq ft showroom at 206-208 N. Michigan Ave., offers heating and air conditioning contractors and wholesalers the opportunity to see boilers, baseboard heating, air conditioning systems, and water heaters.

▸ In October it was reported in these pages that the *CLARAGE FAN CO.* had purchased the remaining plant and facilities of the defunct *KALAMAZOO STOVE AND FURNACE CO.* Some of our readers misconstrued the Kalamazoo Stove Co. for its successor, the *KALAMAZOO FURNACE & APPLIANCE MFG. CO. C. C. WHITCOMB*, president of the Kalamazoo Furnace & Appliance Mfg. Co., reports that facilities of his firm are expanding and that a full line of 41 models of oil, gas, and coal fired furnaces is being produced. His company purchased, several years ago, one of the large factory buildings which was formerly part of the Kalamazoo Stove Co. property. A new office building was built adjoining this structure.

WE HEAR THAT

Continued

▸ *TRANE CO.* will erect a new plant on a 103 acre site in Clarksville, Tenn., which will manufacture central type residential air conditioning units. Target date for completion of the structure is February 1. In other activity, the company has introduced the "zinc rich coat" system on evaporative condensers, spray coil units, spray coil climate changers, and air washers. Shipping time is saved with the new method, according to firm officials. At the same time, they said sales engineers representing more than 110 Trane sales offices located in the United States and Canada participated in the firm's 1957 engineering seminar.

▸ A new electric arc furnace and associated equipment will be added to *BABCOCK & WILCOX CO.'s* alloy and stainless steel making facilities. Costing between $12 and $14 million, the project is scheduled for completion during the fall of 1959.

▸ *MOR-FLO HEATER CORP.* has begun production in a second plant at 9520 Woodland Ave., Cleveland. The new 21,000 sq ft structure will be devoted entirely to increased production.

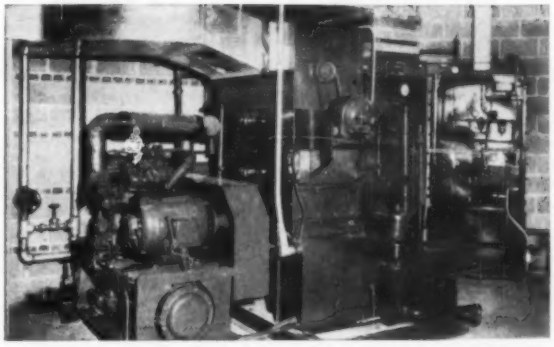
▸ *LEHIGH MFG. CO.* is moving its condensing unit and compressor manufacturing facilities from Lancaster, Pa., to the company's Easton, Pa., plant. Transfer of equipment will be completed this month.

▸ *TAYLOR-WINFIELD CORP.* has purchased facilities and inventories used by *STRUTHERS-WELLS CORP.* in the design, manufacture, and sale of their line of metal forming and work handling machinery.

▸ Construction of *WALWORTH CO.'s* new $5 million brass valve manufacturing plant and engineering research laboratory in Braintree, Mass., began recently with a cornerstone laying ceremony. Scheduled for completion in July 1958, the new facility will have a total floor area of approximately 300,000 sq ft.

▸ The Los Angeles and San Francisco offices of *ARMSTRONG CORK CO.'s INSULATION DIV.* have been merged to form the San Francisco-Los Angeles district office. *JOHN S. TAYLOR*, current district manager of the San Francisco office, has been named district manager for the combined operation. *MANN C. SWEET* of the Los Angeles office will serve as branch manager at Los Angeles. *A. B. CALLOW*, former district manager at Los Angeles, has retired following more than 45 years of service with the company.

DRY AIR...
PRECISELY as you want it



NIAGARA CONTROLLED HUMIDITY AIR CONDITIONING

This method removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the leaving air. Heating or cooling is done as a separate function.

The Niagara's Controlled Humidity Method using HYGROL moisture-absorbent liquid is

Best and most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always.

Most reliable because . . . the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Easiest to take care of because . . . the apparatus is simple, parts are accessible, controls are trustworthy.

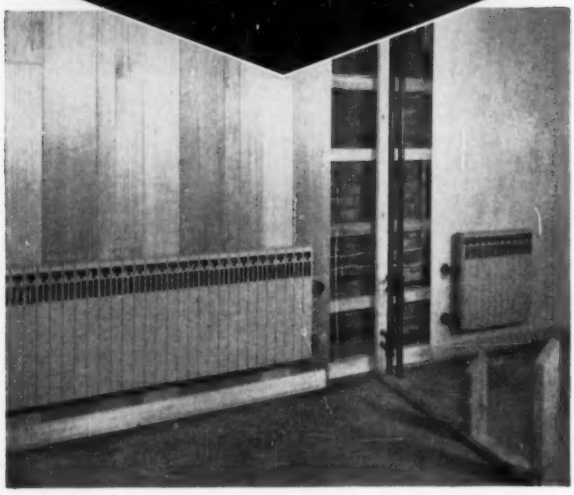
The cleanest because . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

AT THE
CHEMICAL SHOW
26th EXPOSITION OF CHEMICAL INDUSTRIES
Coliseum, New York City, December 2 – 6, 1957
See NIAGARA
AIR CONDITIONERS • *Aero* HEAT EXCHANGERS
Aero AFTER COOLERS • *Aero* REFRIGERANT CONDENSERS • *Aero* STEAM CONDENSERS
Aero VAPOR CONDENSERS • HUMIDIFIERS
HEATERS • COOLERS • DRYERS
BOOTH No. 655

Write for full information; ask for Bulletins 112 and 121. Address Dept. HP-12

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N. Y.
District Engineers in Principal Cities of U.S. and Canada

REDUCE piping costs . . . SPEED installation



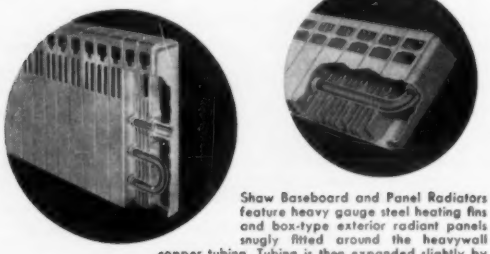
with

SHAW Radiators

Only Shaw, of all modern radiators, offers *same end* as well as opposite end tapping. Same end tapping has a place in almost every piping layout, and its use invariably means less piping materials, simplified pipe fitting.

Important savings in installation time are made with *any* Shaw model, regardless of tapping arrangement. Shaw units are compact, fully self-contained assemblies only 3" thick, easy to handle and mount. There are no dampers, or separate housings to fit and install.

Shaw Radiators distribute both radiant and convected heat in unvarying, health-guarding proportions that create natural thermal comfort in a room. They use either hot water or steam up to 150 psi. Write today for free literature on both panel and baseboard models.



Shaw Baseboard and Panel Radiators feature heavy gauge steel heating fins and box-type exterior radiant panels snugly fitted around the heavywall copper tubing. Tubing is then expanded slightly by 3750# hydraulic pressure to hold all components as a rigid, self-contained unit. The tight metal-to-metal bond assures rigidity and full heat conduction.

SHAW-PERKINS MANUFACTURING COMPANY
201 East Carson St. • Pittsburgh 19, Pa.

WE HEAR THAT

Continued

▸ A plan of reorganization is being considered under which *ANACONDA CO.* would acquire all of the assets of *COCHRAN FOIL CO.* and assume all of the liabilities of the latter company in exchange for capital stock of Anaconda Co. on the basis of one share of Anaconda stock for each 2½ shares of Cochran Foil. Under the proposed plan, Cochran Foil would be dissolved and the Anaconda shares distributed to Cochran Foil shareholders.

▸ A line pipe mill for manufacturing welded steel, stainless steel and aluminum pipe and tubing in the 4½ to 14 in. size range will be erected in Jacksonville, Fla., by *ALUMINUM TUBING CO.* The firm expects to begin producing at the new mill during March of next year.

▸ *YORK CORP., SUBSIDIARY OF BORG-WARNER CORP.*, has concluded negotiations with the *LEHIGH MFG. CO., DIV. LEHIGH, INC.*, for the purchase of the latter's automotive air conditioning compressor design and related manufacturing facilities in Lancaster, Pa.

▸ *WATER SERVICE LABORATORIES, INC.* has leased for its main office 18,000 sq ft of space in the Rogers Bldg., 615 W. 131st St., New York. The firm has also leased for its Philadelphia office an 11,000 sq ft building at 169 W. Wyoming Ave.

▸ A new $1,600,000 factory addition containing $1,100,000 worth of equipment is now being operated by *LOUIS ALLIS CO.* The installation adds 121,000 sq ft of manufacturing floor space. The firm also has constructed a 37,000 sq ft, four floor office addition.

▸ *RECOLD CORP.* is opening warehouses in Georgia and New Jersey. Both will be operated by personnel from the company's headquarters in Los Angeles. Recold is celebrating its 25th anniversary this year as a manufacturer of commercial and industrial air conditioning and refrigeration equipment.

▸ *AMANA REFRIGERATION, INC.* will display its 1958 air conditioners to distributors in a series of regional meetings slated during the early part of December. Sessions are scheduled at Amana, Iowa; New York City, Atlanta, Dallas, Los Angeles, and Portland, Oreg.

WE HEAR THAT

Continued

▸ *HAVEG INDUSTRIES, INC.* has acquired *LITHGOW CHEMICAL CO.* of California, manufacturers and applicators of corrosion resistant plastic coatings, cements, impregnations, and laminated linings. According to *DR. JOHN H. LUX*, Haveg's president, the Lithgow organization will be operated as a division of Haveg.

▸ Headquarters of *RECONY CORP.* have been transferred to the firm's Richmond, Va., plant from New York City.

▸ *WORTHINGTON CORP.* dealers and wholesalers attended the firm's annual air conditioning and refrigeration service meetings. The sessions took place for nine weeks at the corporation's East Orange, N. J., manufacturing plant.

▸ *PENNSALT CHEMICALS CORP.* has named *AMERICAN POTASH & CHEMICAL CORP.* a national distributor for its "Isotron" refrigerant chemicals. The agreement becomes effective January 1 of next year.

▸ Sales and marketing executives from the midwest gathered at Chicago's Morrison Hotel recently for the Chicago Field Sales Management Course. The session, which covered training in field sales supervision, was cosponsored by *NATIONAL SALES EXECUTIVES, INC.* and the *CHICAGO SALES EXECUTIVE CLUB.*

▸ *CARRIER CORP.* has introduced gas and oil fired steel boilers designed to supply steam or hot water for heating commercial buildings of moderate size. At the same time, the company announced the production of its 4000th centrifugal refrigerating unit.

▸ *AMERICAN AIR FILTER CO.* conducted a two week sales school for new sales engineers. The course was designed to improve sales techniques and product knowledge of individual salesmen.

▸ *OIL HEAT INSTITUTE OF AMERICA* has established a news bureau with offices in Baltimore. The bureau will disseminate periodic releases and feature articles to newspapers, national trade and consumer magazines, radio, television, and a variety of company publications. ‡

Since 1925 The Webster Engineering Company has devoted its entire efforts to the designing, manufacturing and the applying of modern burner and automatic control equipment.

Webster

Burners & Controls

Webster Burners are practically standard equipment with numerous large utilities and every industry where gas and oil are used as fuels.

Webster's facilities permit it to recommend the equipment required to produce the desired results at a reasonable cost. Webster units are not loaded with gadgets.

•

Webster's engineers are ready to prepare specifications for any type or size gas and/or oil burning installation.

Webster equipment is marketed through ◎JANITROL district offices and many other exclusive agents.

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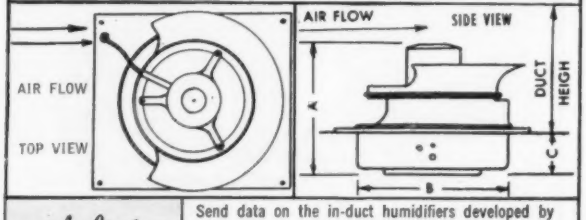
Company
TULSA 16, OKLAHOMA

Division of SURFACE COMBUSTION CORPORATION, Toledo, Ohio

NEW, CENTRIFUGAL, IN-DUCT HUMIDIFIER
MORE COMPACT— INSTANT ACTION
HONEST HUMIDIFICATION FOR REAL WINTER AIR CONDITIONING

Walton has the only complete line of humidifiers—engineered to any type job. Technical information on how this equipment can be applied to your specific air conditioning problem on request.



Walton

AUTHORITIES ON HUMIDIFICATION SINCE 1930

Send data on the in-duct humidifiers developed by Walton. Want more details on the product, the application, and how I can develop this new business. No obligation.

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Name of Company.....
Address.....
City.....Zone.....State.....
Type of business.....Architect.....Engineer.....Contractor

Walton Laboratories, Inc., Dept. HP-12 Irvington 11, N. J.

MEETINGS & CONVENTIONS

1958

JAN. 14-15—*Instrument Society of America*, symposium. Hotel Bradford, Boston. Information: ISA, Boston Section, Inc., Box 282, Boston 1.

JAN. 27-29—*American Society of Heating and Air-Conditioning Engineers, Inc.*, 64th annual meeting. Penn-Sheraton Hotel, Pittsburgh. Information: A. V. Hutchinson, executive secretary, ASHAE, 62 Worth St., New York 13.

JAN. 27-30—1958 *Plant Maintenance and Engineering Show*. International Amphitheater, Chicago. Management: Clapp & Poliak, Inc., 341 Madison Ave., New York 17.

FEB. 3-4—*Instrument Society of America*, national conference on progress and trends in chemical and petroleum instrumentation. Wilmington, Del. ISA headquarters: 313 Sixth Ave., Pittsburgh 22.

FEB. 4-6—*Society of the Plastics Industry, Inc.*, 13th SPI reinforced plastics division conference. Edgewater Beach Hotel, Chicago. SPI headquarters are at 250 Park Ave., New York, 17.

FEB. 17-20—*Seventh Annual Industrial Ventilation Conference*. Kellogg Center, Michigan State University, East Lansing, Mich. Information: Industrial Ventilation Conference, Continuing Education Service, Michigan State University, East Lansing, Mich.

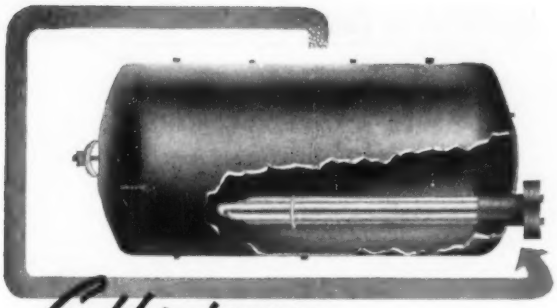
MARCH 1—*Association for Applied Solar Energy*, first junior solar symposium. Arizona State College, Tempe, Ariz. AASE headquarters: Suite 202, Central Plaza Bldg., Phoenix, Ariz.

MARCH 17-21—*National Association of Corrosion Engineers*, annual conference and exposition. Civic Auditorium, San Francisco. NACE headquarters: 1061 M & M Bldg., Houston 2.

MARCH 17-21—1958 *Nuclear Congress*. International Amphitheater, Chicago. Information: Engineers Joint Council, 29 W. 39th St., New York 18.

MARCH 31-*APRIL* 2—*Gas Appliance Manufacturer's Association*, annual meeting. The Greenbrier, White Sulphur Springs, W. Va. GAMA headquarters: 60 E. 42nd St., New York 17.

MAY 4-7—*Air-Conditioning and Refrigeration Institute*, annual meeting. The Homestead, Hot Springs, Va. ARI headquarters: 1346 Connecticut Ave., N. W., Washington 6, D. C.



Efficiency is a must in your HOT WATER GENERATOR

TANKS
SMOKESTACKS
PIPING
WATER HEATERS
BREECHING
PLATE WORK
BOILERS

Here is a Hot Water Generator that will give you the maximum in efficiency! *More* hot water at *less* operating cost. Quality of constructions is your assurance of the maximum operating efficiency from your FINNIGAN equipment. Adaptable to any type operation—built to your specification in capacities from 66 to 5,000 gallons, FINNIGAN Hot Water Generators are made from the finest material and contain copper removable-coil heating element. They are equipped with large size tappings which can be bushed to fit any job.

Call, wire or write today for further information . . . there is no obligation.

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American Air Filter Co., Inc.
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Louisville 8, Kentucky

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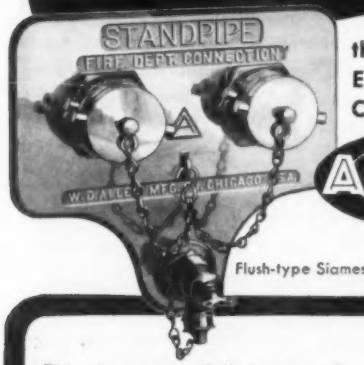

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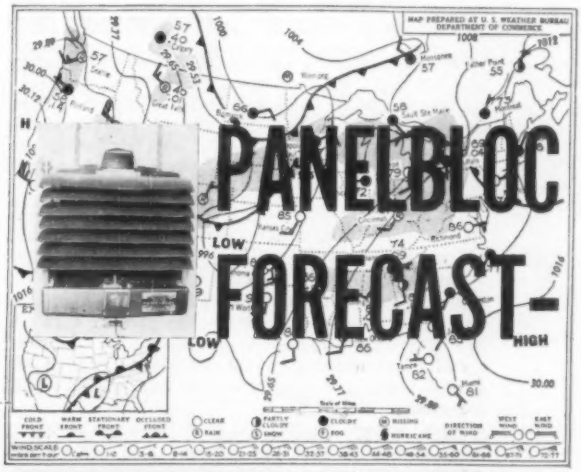

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MAY 7-11—*Western Air Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference.* Shrine Exposition Hall, Los Angeles. Sponsored by Western Air Conditioning Industries Association. Information: Fred J. Tabery, exhibit manager, 3443 S. Hill St., Los Angeles 7.

MAY 11-14—*Fluid Controls Institute.* Lake Placid Club, Lake Placid, N. Y. Information: Fluid Controls Institute, Inc., P. O. Box 191, Decatur, Ill.

MAY 19-23—*National Fire Protection Association,* annual meeting. Palmer House, Chicago. The association is at 60 Batterymarch St., Boston.

JUNE 2-5—*National District Heating Association,* 49th annual meeting. French Lick-Sheraton Hotel, French Lick, Ind. Information: John F. Collins, secretary-treasurer, 827 N. Euclid Ave., Pittsburgh.

JUNE 9-13—*Fourth International Automation Exposition and International Automation Congress.* Coliseum, New York. Information: Richard Rimbach Assoc., 845 Ridge Ave., Pittsburgh 12.

JUNE 22-27—*American Society for Testing Materials,* annual meeting. Hotel Statler, Boston. Information: 1916 Race St., Philadelphia 3.

JUNE 23-25—*American Society of Heating and Air-Conditioning Engineers, Inc.* and *American Society of Refrigerating Engineers,* joint meeting. Hotel Leamington, Minneapolis. ASHAE headquarters: 62 Worth St., New York 13. ASRE headquarters: 234 Fifth Ave., New York 1.

AUG. 7-9—*North Carolina Hospital Engineers Association, Inc.,* 1958 convention. Sir Walter Hotel, Raleigh, N.C. Headquarters: Oteen, N.C.

OCT. 5-8—*National Association of Corrosion Engineers,* technical session. Hotel Somerset, Boston. NACE headquarters: 1061 M & M Bldg., Houston 2.

OCT. 12-16—*American Gas Association,* annual convention. Atlantic City. AGA headquarters: 420 Lexington Ave., New York 17.

OCT. 20-24—*46th National Safety Congress & Exposition,* Chicago. National Safety Council, 425 N. Michigan Ave., Chicago 11.

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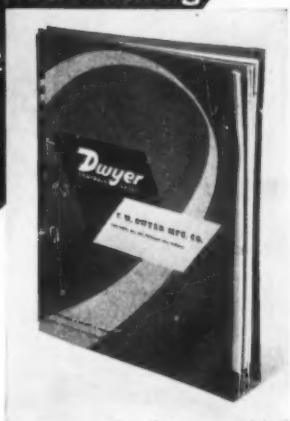

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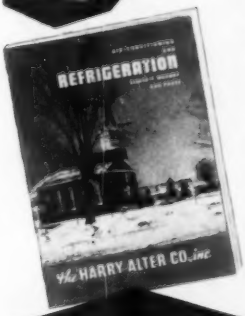

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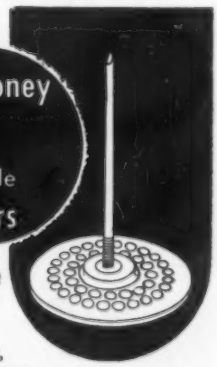

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OCT. 22-24—*Air-Conditioning and Refrigeration Wholesalers Association*, annual meeting. Sheraton-Palace Hotel, San Francisco. Information: 2607 N. High St., Columbus, Ohio.

NOV. 17-21—*Society of the Plastics Industry, Inc.*, eighth national plastics exposition. International Amphitheater, Chicago. To be held concurrently with the SPI annual national conference, Morrison Hotel, Chicago. SPI headquarters: 250 Park Ave., New York 17.

DEC. 1-3—*American Society of Refrigerating Engineers*, semi-annual meeting. Hotel Roosevelt, New Orleans. Information: 234 Fifth Ave., New York 1.

DEC. 1-4—*National Warm Air Heating and Air Conditioning Association*, annual convention. Cleveland, Ohio. Information: 640 Engineers Bldg., Cleveland 14. ‡

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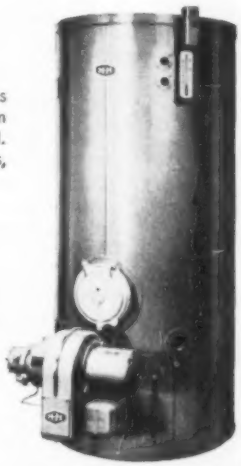

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STUDY, HIGH PERFORMANCE CABIN COOLING UNIT — By A. P. Lane. 159 pp. Order PB 121284, Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. $4.00.

APPLICATION OF OVERFIRE JETS TO PREVENT SMOKE FROM STATIONARY PLANTS — Revised Ed. BCR technical publication. 24 pp. Technical Information Dept., Bituminous Coal Research, Inc., 121 Meyran Ave., Pittsburgh 13. 50c.

THERMODYNAMICS FOR CHEMICAL ENGINEERS — Second Ed. By Harold C. Weber and Herman P. Meissner. 507 pp. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. $8.50.

SUMMARY OF COOLING SYSTEM STUDY — Part One of *Equipment Cooling Systems for Aircraft*. By R. H. Zimmerman and W. Robinson. 88 pp. Order PB 121256, Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. $2.25.

NATIONAL FIRE CODES — NFPA publication. Three volumes are: *Flammable Liquids and Gases*, 896 pp.; *Combustible Solids, Dusts, Chemicals and Explosives*, 624 pp.; *Building Construction and Equipment*, 736 pp. National Fire Protection Association, 60 Batterymarch St., Boston 10. $6.00 per volume.

STUDIES OF THERMAL CONDUCTIVITY OF LIQUIDS, PART THREE — Reprint Series No. 28. By Byron C. Sakiadis and Jesse Coates. Engineering Experiment Station, Louisiana State University, Baton Rouge 3, Louisiana. 25c.

INDUSTRIAL HYGIENE QUARTERLY—American Industrial Hygiene Association, 14125 Prevost, Detroit 27. 25c.

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or if you're feeling queerly

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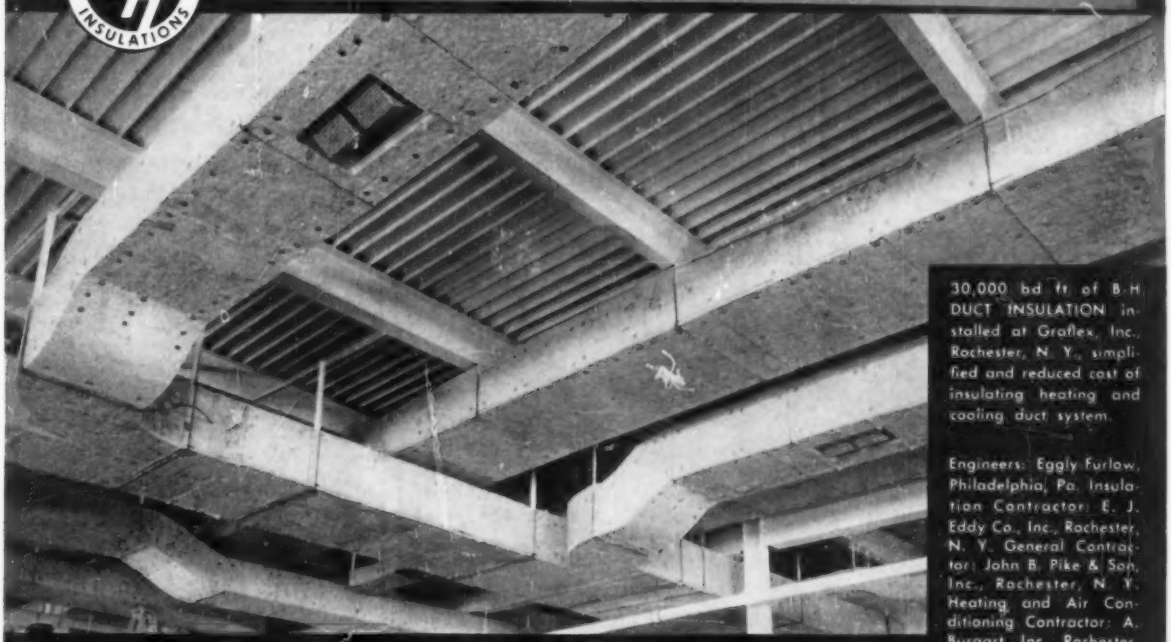
American Cancer Society

BALDWIN-HILL

DUCT INSULATION



30,000 bd ft of B-H DUCT INSULATION installed at Graflex, Inc., Rochester, N. Y., simplified and reduced cost of insulating heating and cooling duct system.

Engineers: Eggly Furlow, Philadelphia, Pa. Insulation Contractor: E. J. Eddy Co., Inc., Rochester, N. Y. General Contractor: John B. Pike & Son, Inc., Rochester, N. Y. Heating and Air Conditioning Contractor: A. Burgart, Inc., Rochester, N. Y.

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B-H DUCT INSULATION is easily cut and fitted to irregular flat shapes.

Curved surfaces effectively insulated by scoring and bending B-H DUCT INSULATION.

Low Installed Cost—High Insulating Efficiency—Low Operating Expense

Easy cutting, fitting and application, even to curved surfaces, add up to provide a low installed cost of B-H Duct Insulation. It proves easier and quicker to apply than semi-rigid materials adapted for the purpose.

B-H spun mineral wool Duct Insulation has a high thermal efficiency which lowers air conditioning and heating costs. Here at Graflex, Inc. this insulation maintains uniform temperature from beginning to end of these long run ducts. Plain duct insulation was used because a suspended ceiling, installed after this picture was taken, creates a cooling and heating plenum. Air in the plenum is conditioned to keep humidity low, eliminating need for a vapor barrier over the insulation. B-H Duct Insulation is available also with factory-applied vapor barrier, and coated to prevent fiber entrainment.

More information available in brochure suggesting methods of application. See Sweet's Engineering File for other B-H insulating products.

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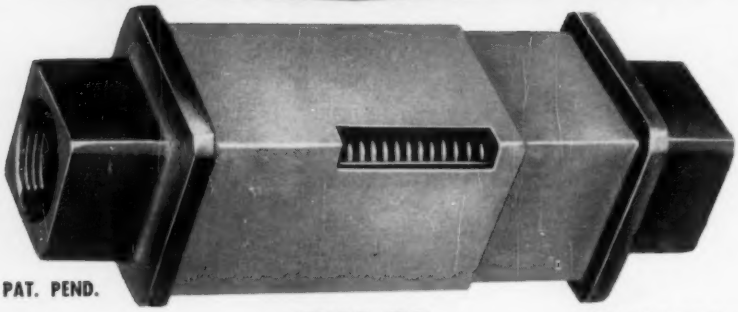

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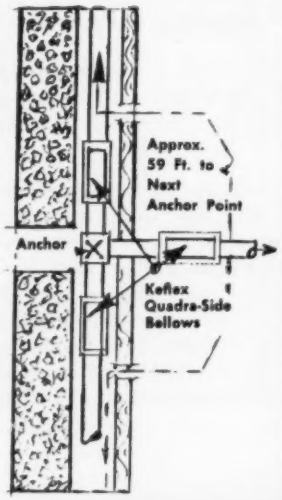

● **ROUND** KEFLEX Bellows are made of Laminated Stainless Steel, multiple ply (usually 2 ply or more) for greater strength with minimum force required to move bellows. The minimum force to move 7 Q Keflex Bellows greatly reduces the need for additional anchoring above that required to handle line pressure thrust force as the force to move Keflex 7 Q only is always less than 100 lbs.

● **FLAT** KEFLEX FLAT GUIDES offer so many advantages it is difficult to mention them all. Briefly: The KEFLEX FLAT OUTSIDE GUIDE (shroud) is made of brass USUALLY formed square of required length —one unit end will telescope over other unit end. The flat surfaces slide over and in one another—practically eliminating possibility of torque as result of faulty installation. This ASSISTS PROPER GUIDING.

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FREON* REFRIGERANTS IN AIR CONDITIONING

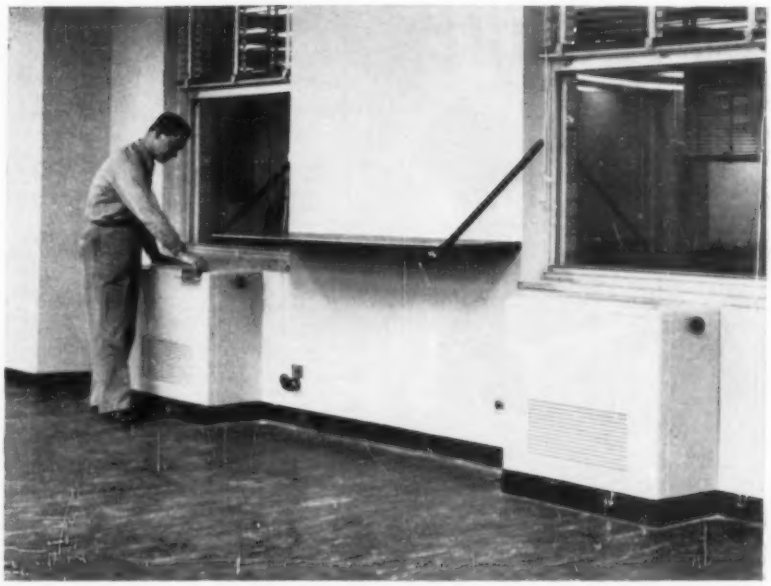
Field Reports About Successful Installations

Unit system combined with central system cools modernized building

An unusual dual air conditioning system was incorporated in the plans for interior modernization of the 15-story office building at 72 Wall Street, New York City. Architects Vorhees, Walker, Smith & Smith working with Contractors George A. Fuller Co. and J. H. Taylor Construction Co., Inc., designed a layout blending a Carrier duct-distributed, central system with a Remington Incremental System.

These systems divide the building's 665-ton cooling load at about half the installation cost of a full central system.

The Carrier system cools lower five floors plus interior of the top 10 floors. 459 Remington unit conditioners, built in under the windows, air condition peripheral offices of the top 10 floors. For installation of the Remington units, holes were cut in the masonry to receive air-intake ducts. Grillwork sets flush with the building and does not substantially alter its exterior appearance. (See above.)



Unit system in outside offices permits occupants to control temperatures for year-round comfort

Above shows how Remington units line the walls beneath windows in a typical office area at 72 Wall Street. Each cabinet houses a ¾- or 1-ton unit for cooling plus a separate heating coil connected to the building's steam system. Each unit incorporates a thermostat plus fan controls (shown right), which allow occupant to select the temperature he prefers year round. With this unit control system, heating or cooling can be economically confined to occupied areas without the need to air condition the entire building. The cooling unit is drawer-mounted and can be easily removed for maintenance or repair by simply disconnecting five wires.

Each Remington unit and the Carrier system uses "Freon" refrigerants to help insure effective performance with minimum maintenance.

How Du Pont leadership in refrigerants means better performance for installations you plan

Today's more compact, more efficient equipment has grown in part from Du Pont's pioneering in development and manufacture of improved "Freon" refrigerants. Improved manufacturing techniques developed by Du Pont make "Freon" the refrigerant that sets the industry's standard for purity and performance. That's why you can be sure the air conditioning and refrigerating installations you plan will deliver better performance when charged with "Freon". You can't select a better refrigerant than safe, acid-free, dry "Freon" refrigerant.

For data on applications, performance or properties of "Freon", write *E. I. du Pont de Nemours & Co. (Inc.), "Freon" Products Division #712, Wilmington 98, Del.*

FREON® REFRIGERANTS

**Freon and combinations of Freon- or F- with numerals are Du Pont's registered trademarks for its fluorinated hydrocarbon refrigerants.*

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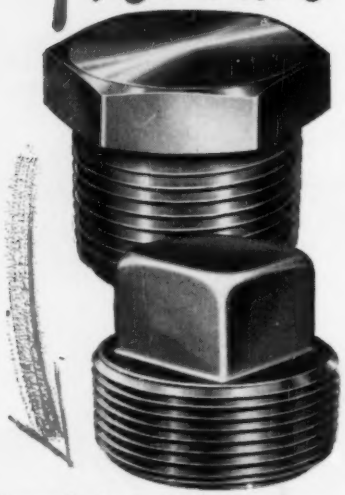
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

plugs for Pressure



forged steel, high pressure plugs with **DRY SEAL** tapered threads

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Square Head Solid Plugs sizes 1" thru 2", all forged steel. Hex Head Plugs sizes ½" thru 2" machined from solid bar.

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COUPLINGS — NIPPLES — UNIONS — BUSHINGS — PLUGS — REDUCERS — CAPS—CAPADAPTERS—WELL SUPPLIES

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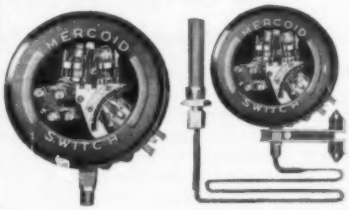

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You really ought to try Bethcon. Why not call us now?

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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BETHLEHEM STEEL

BETHLEHEM STEEL

Men
who know
specify
GACO

to stop corrosion in
cooling tower drip pans

GACO

THE MARK OF CORROSION PROTECTION

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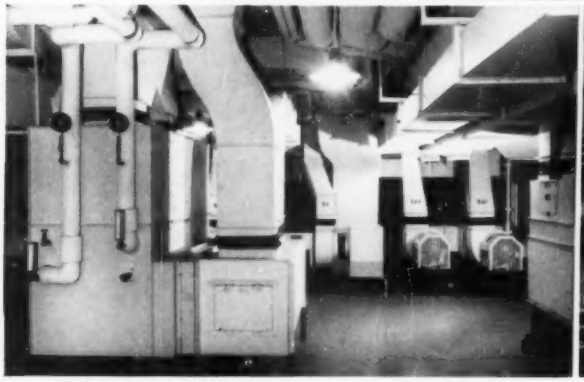
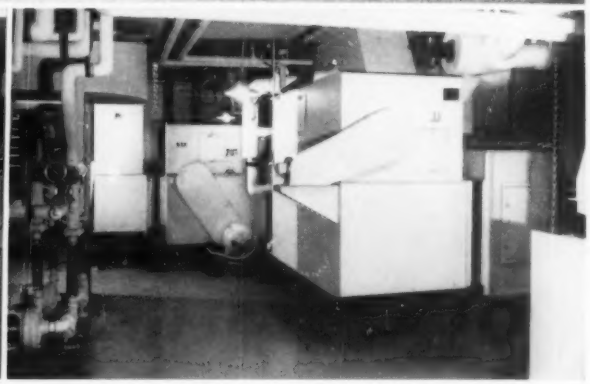


On left, Clarage Multitherm supplying conditioned air to the electrophoresis balance room. Exhaust fans in background.



In foreground, Multitherm supplying make-up air exhausted by laboratory hoods.

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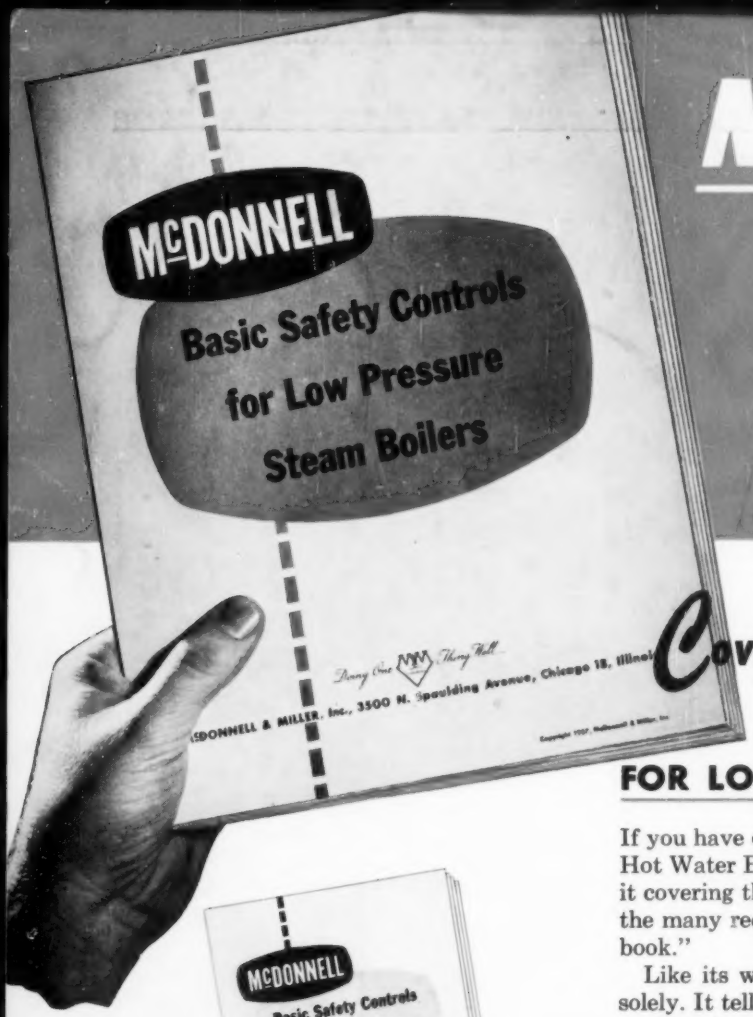
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